The Journal of the

INSTITUTE OF METALS

and

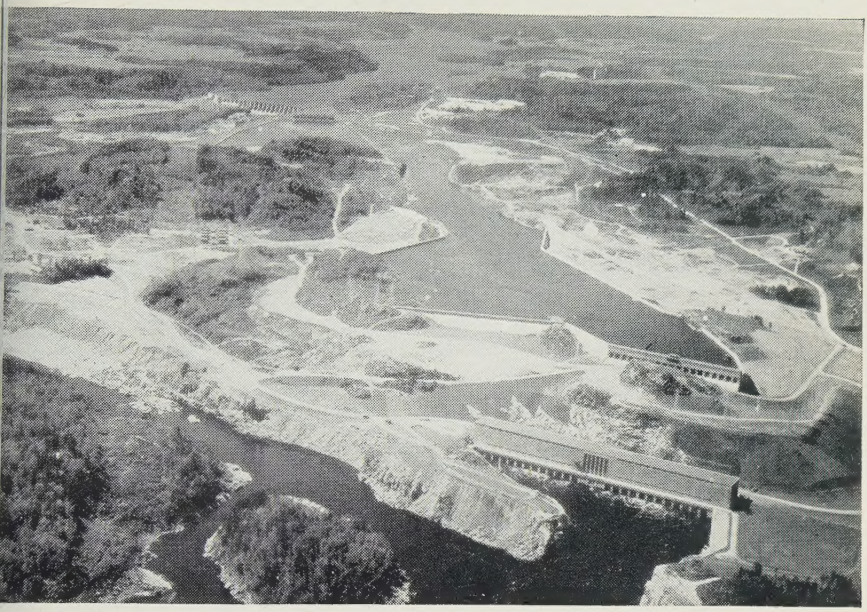
METALLURGICAL ABSTRACTS

In this Issue:

FEBRUARY 1948

Entered at Stationers' Hall

Background to Achievement



Shipshaw No. 2 powerhouse and headblock. The powerhouse is 875 feet long and houses 12 generators with a total capacity of 1,200,000 h.p. Shipshaw is operated by Aluminum Company of Canada, Ltd., for the Aluminium Limited Group.

TODAY, Canada takes pride of place as the largest source of virgin aluminium in the British Commonwealth. Behind this achievement es a fascinating story, involving important new enterprises by the luminium Limited Group; of the harnessing of Canada's vast water ower; of a complete new town at Arvida in the province of Quebec; and he construction of huge new production and fabricating plant. All this to ne end—the growth of large-scale production and distribution of alumin-m and its alloys from mine to market. The trade and industry of Great ritain have been well served; still greater service will be our constant object.

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The largest distributors of Aluminium and its Alloys in the British Commonwealth

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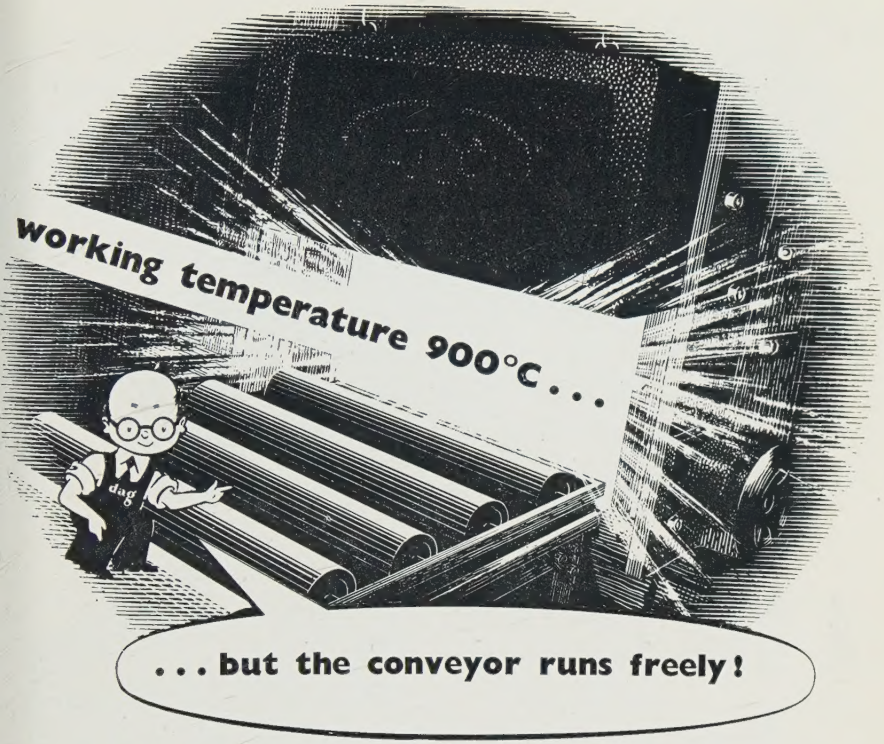

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Please send Leaflet 63 and other information on High Temperature Lubrication with 'dag' Colloidal Graphite.

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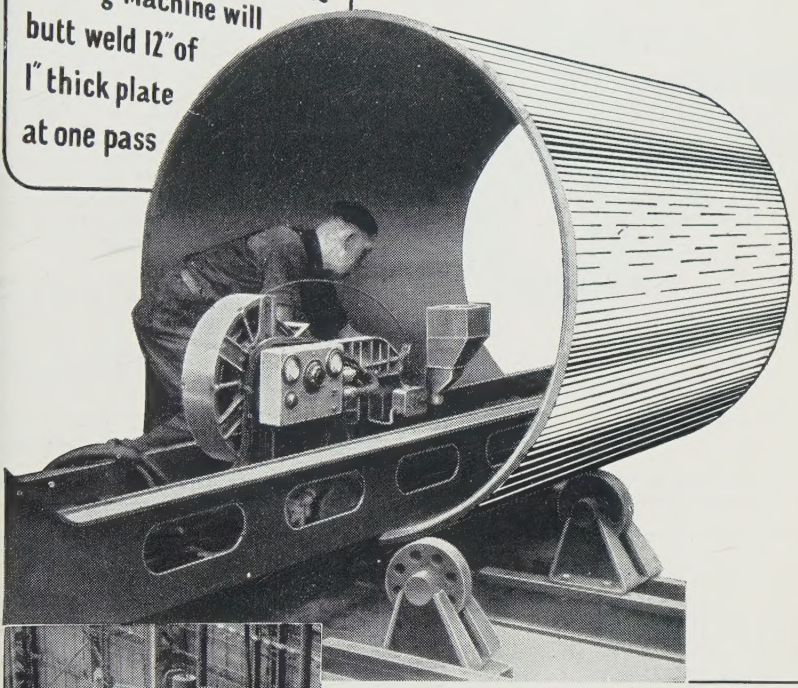
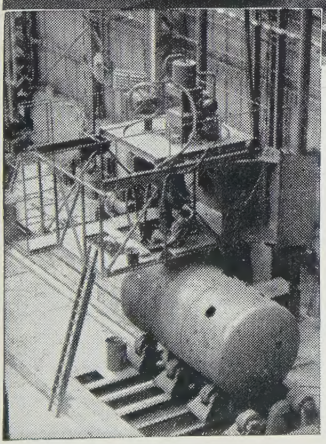
In one minute . . . starting now

The Unionmelt Automatic Welding Machine will butt weld 12″ of 1″ thick plate at one pass





Of all methods of making butt, fillet and plug welds in mild steel plate, Unionmelt Automatic Electric Welding is the fastest—it does the job ten to twenty times faster (according to conditions) than by hand !

A submerged arc, granular flux and continuous electrode characterise this efficient process.

The illustrations show Unionmelt Equipment in use in pressure vessel fabrication at Messrs. G. A. Harvey & Co, (London) Ltd., Greenwich. In boiler manufacture, the construction of large containers and pressure vessels, in the making of railway wagons and in the shipbuilding industry, Unionmelt Welding Equipment is increasing the flow of high-quality production.

Further particulars supplied upon request to The British Oxygen Company Limited, Sales Technical Service Department, North Circular Road, Cricklewood, N.W.2.

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Gas helps to step-up production of all kinds of exportable goods because it can provide high flame temperatures instantly. It gives quick-starting and economical shut-down. It means exact, automatic temperature control and uniform heat distribution which safeguard quality and reduce spoilage. It makes minimum demands on maintenance, on personnel and on the Nation's coal supplies.

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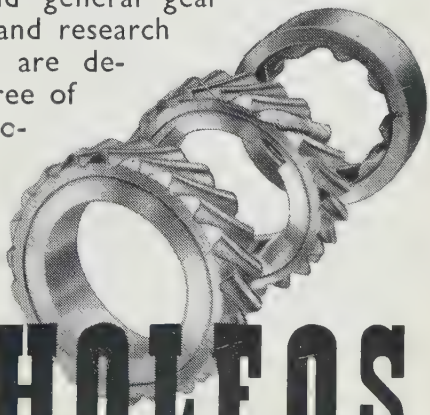

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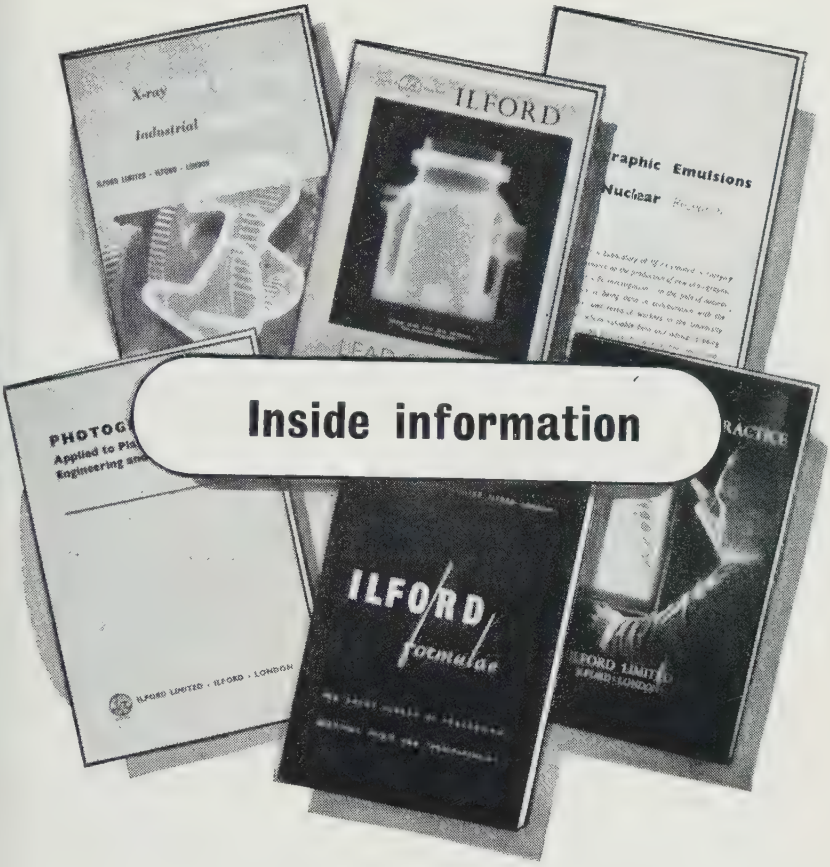

Many of the problems arising in the normal practice of industrial photography and radiography are answered in the appropriate Ilford publications. These valuable sources of information and reference are available for photographers and radiographers working in the industrial field.

Individual problems will be gladly dealt with by the Ilford Technical Service Department whose advice and co-operation are always available to users of Ilford Photographic Materials.

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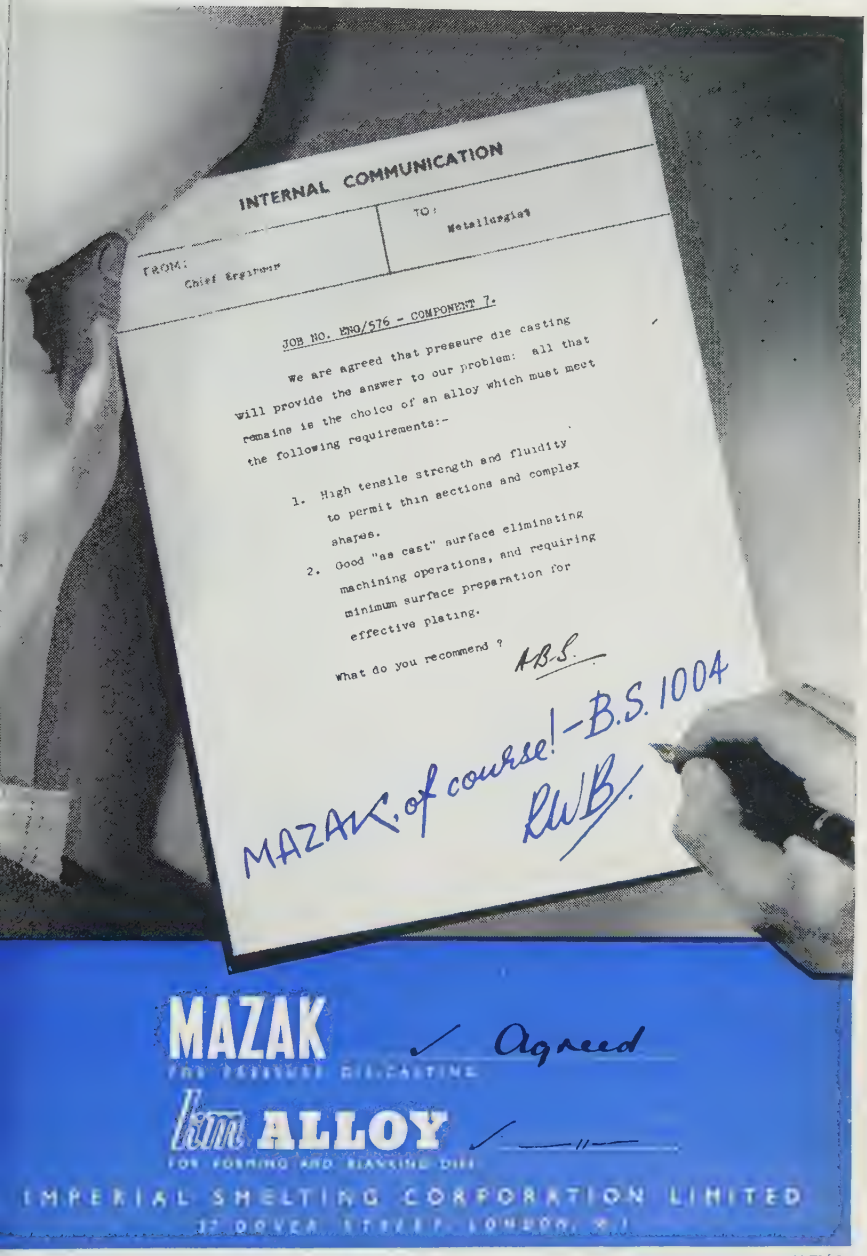
INTERNAL COMMUNICATION
FROM: Chief Engineer
TO: Metallurgist
JOB NO. ENG/576 - COMPONENT 7.
We are agreed that pressure die casting will provide the answer to our problem: all that remains is the choice of an alloy which must meet the following requirements:-
1. High tensile strength and fluidity to permit thin sections and complex shapes.
2. Good "as cast" surface eliminating machining operations, and requiring minimum surface preparation for effective plating.
What do you recommend ?
A.B.S.
MAZAK, of course! - B.S. 1004
R.W.B.
MAZAK
FOR PRESSURE DIE-CASTING
✓ Agreed
Zim ALLOY
FOR FORMING AND BLANKING DIES
✓ —"—
IMPERIAL SMELTING CORPORATION LIMITED
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M-W.60

QUIZ No. 4

"Next question, Mr. Bigtiffin . . . How do pukka engineering sahibs set about solving their corrosion problems in the tropics?"

Mr. Bigtiffin squared up to the microphone with the air of a man shouldering the white man's entire burden.

"I have been out East 35 years," he said. "I have built in swamps that wanted draining and jungles that had to be cleared, and wherever I've built, I have had to reckon with conditions of heavy rains five months out of twelve. Corrosion has always been one of our biggest bugbears, and it wasn't until a few years ago we discovered a satisfactory method of dealing with it. Metal Coatings. That's what we use nowadays. Sprayed in situ by the British wire process."

"Just how do you spray it?" asked the announcer.

"With a Metallisation Pistol," replied Mr. Bigtiffin emphatically. "That Pistol has meant as much to us as a 15" gun to the Navy."

THE JOURNAL OF THE INSTITUTE OF METALS

FEBRUARY 1948

Contents

INDEX TO ADVERTISEMENTS

February 1948.

THE INSTITUTE OF METALS

INSTITUTE NEWS AND ANNOUNCEMENTS

CAPPER PASS AWARDS

The Directors of Messrs. Capper Pass and Son, Ltd., Bristol, share in the regret which has been expressed in many quarters at the dearth of papers on processes and plant used in extraction metallurgy in the *Transactions of the Institution of Mining and Metallurgy*, and of papers on processes and plant used in the fabrication of non-ferrous metals in the *Journal of the Institute of Metals*, and have offered to these Institutions the sum of £200 per annum for a period of 7 years to be applied as follows :

(*a*) £100 per annum to be available for one or more awards to the authors of papers on some aspect of non-ferrous extraction metallurgy ;

(*b*) £100 per annum to be available for one or more awards to the authors of papers relating to some process or plant used in the extraction or fabrication of non-ferrous metals ;

contributed by persons engaged full time in industrial practice.

The Councils of the Institution of Mining and Metallurgy and of the Institute of Metals have gratefully accepted this offer, and have appointed a joint Adjudicating Committee.

This Committee has power to make the awards on behalf of the two societies and may, at its discretion, make no award or awards of less than the money available if, in its opinion, the quality or number of papers submitted in any year fails to reach a suitable standard. Any sums not awarded will be carried forward to future years.

The Councils of the Institution of Mining and Metallurgy and of the Institute of Metals hope that the generous offer made by Messrs. Capper Pass and Son, Ltd., will stimulate the writing of many papers of the types for which the awards are to be made. Papers on extraction metallurgy should preferably be submitted to the Institution of Mining and Metallurgy, while those on processes and plant used in the fabrication of non-ferrous metals should preferably be offered to the Institute of Metals. Both societies are prepared to accept papers of suitable quality from non-members.

Authors should note that applications should not be addressed to the Adjudicating Committee requesting that their papers should

be considered for an award. All papers published by both societies will be examined by the Committee annually, and notices of the awards will be published in the journals of the two societies and in the Press. The Committee will consider in due course all papers published by the two societies during 1948.

DINNER TO DR. J. F. THOMPSON

Dr. J. F. Thompson, Executive Vice-President of the International Nickel Company of Canada, Ltd., who was recently elected an Honorary Member of the Institute in recognition of his distinguished services to science and to the non-ferrous metal industries, arrived in England in January. The Council took the opportunity to hold a small dinner party in his honour at the Savoy Hotel, London, on 22 January.

There were present: Colonel P. G. J. Gueterbock (President), Sir William Griffiths (Past-President), Sir Arthur Smout (President-Elect), Mr. W. A. C. Newman (Hon. Treasurer), Professor G. Wesley Austin, Mr. John Cartland, Mr. Roosevelt Griffiths and Dr. J. L. Haughton (Vice-Presidents), and Lieut.-Colonel S. C. Guillan (Secretary).

The President proposed the health of the guest of the evening, and Dr. Thompson replied expressing his appreciation of his election as an Honorary Member.

ANNUAL GENERAL MEETING, 16, 17, AND 18 MARCH 1948

The 40th Annual General Meeting will be held at the Institution of Civil Engineers, Great George Street, London, S.W.1, on Tuesday, Wednesday, and Thursday, 16, 17, and 18 March, when Sir Arthur Smout, J.P., will be inducted into the Chair as President of the Institute.

A full programme, with reply form, will be despatched to all members, and it is hoped that there will be a large attendance.

PROGRAMME

Tuesday, 16 March

2.30 p.m.—*General Meeting at the Institution of Civil Engineers, Great George Street, London, S.W.1.*

Discussion of papers :

Cook and Larke: "Calculation of Loads Involved in Metal Strip Rolling" (No. **1111**; *Oct.* 1947).

Jointly :

(*a*) Jennings, Singer, and Pumphrey: "Hot-Shortness of Some High-Purity Alloys in the Systems Aluminium–Copper–Silicon and Aluminium–Magnesium–Silicon" (No. **1119**; *Jan.* 1948).

(*b*) Jennings and Pumphrey: "A Consideration of the Constitution of Aluminium–Iron–Silicon Alloys and its Relation to Cracking above the Solidus" (No. **1120**; *Jan.* 1948).

If time permits :

McLean: "Striations: Metallographic Evidence of Slip" (No. **1113**; *Oct.* 1947).

Wednesday, 17 March

10.0 a.m.—Report of Council.
Report of Honorary Treasurer.
Announcement of Election of Officers for 1948–49.
Announcement of Award of Institute of Metals (Platinum) Medal for 1948.
Induction of New President.
Presidential Address, by Sir Arthur Smout, J.P.

1.0 p.m.—*Buffet Lunch* (price 6*s*., for ticket-holders only) at the Royal Institute of Chartered Surveyors, Great George Street, London, S.W.1.

2.30 p.m.—*Discussion of papers :*

NORTHCOTT, MCLEAN, and LEE : " The Effect of Single- and Multi-Hole Die Extrusion on the Properties of Extruded Aluminium Alloy Bar " (No. **1112** ; *Oct.* 1947).

DUDZINSKI, MURRAY, MOTT, and CHALMERS : " The Young's Modulus of Some Aluminium Alloys " (No. **1122** ; *Jan.* 1948).

7.30 p.m.—Buffet Dance at 4 Grosvenor Gardens, London, S.W.1. (Tickets price 17*s*. 6*d*. ; evening dress or uniform).

Thursday, 18 March

10.0 a.m.—*Discussion of papers :*

LATIN : " Pressure and Creep Tests at Constant Hoop Stress on Lead and Alloy 'E' Pipes " (No. **1121** ; *Jan.* 1948).

BRENNER and ROTH : " Recent Developments in Corrosion-Resistant Aluminium–Magnesium Alloys " (No. **1117** ; *Dec.* 1947).

12.45 p.m.—*Buffet Lunch* (price 6*s*., for ticket-holders only) at the Royal Institute of Chartered Surveyors, Great George Street, London, S.W.1.

2.0 p.m.—*Visits to :*

(1) Aluminium Plant and Vessel Co., Ltd., Wandsworth.
(2) Enfield Rolling Mills, Ltd., Brimsdown.
(3) Enfield Cables, Ltd., Brimsdown.
(4) High Duty Alloys, Ltd., Slough.
(5) Murex, Ltd., Rainham, Essex.
(6) Murex, Ltd., Waltham Cross.
(7) J. Stone and Co., Ltd., Charlton.
(8) And a special visit for ladies to the Goldsmiths' Hall, Foster Lane, London, E.C.2, where the magnificent plate and other exhibits of the Worshipful Company of Goldsmiths will be specially displayed. (Tea will be served.)

An inclusive charge of 5*s*. will be made in connection with the works visits, to cover the transport and administrative expenses, but no charge will be made for transport or tea for the ladies' visit.

GIFT OF LIFT GATES

The British Aluminium Company, Ltd., has presented to the Iron and Steel Institute and the Institute of Metals a handsome set of aluminium alloy lift gates and grilles for the entrance hall at 4 Grosvenor Gardens. The Councils of the Institutes have expressed to the Company their appreciation of this gift.

PERSONALITIES

MR. ROBERT CROOKS STANLEY

Mr. Robert Crooks Stanley, Chairman and President of the International Nickel Company of Canada, Ltd., who has been awarded the 1948 Institute of Metals (Platinum) Medal in recognition of his outstanding services to the non-ferrous metal industries, has been with the Company and its predecessors since 1901. He has provided the leadership during the Nickel Company's most intensive growth which has contributed largely to its emergence as one of the world's leading and most successful mining and metallurgical enterprises.

Born at Little Falls, New Jersey, on 1 August 1876, Mr. Stanley was educated at the Stevens Institute of Technology (where he obtained the degree of M.E.) and Columbia University (at which he was awarded the E.M. degree). In 1912 he married Alma Guyon Timolat, and has one son and one daughter.

On the organization of the original International Nickel Company in 1902, Mr. Stanley became Assistant Superintendent of the Camden (N.J.) Works, and subsequently Superintendent. His energy and ingenuity in changing the Camden plant from an Old World chemical manufacturing works of detached units into an integrated undertaking applying up-to-date metallurgical methods drew early attention, and in 1904 he was transferred to Bayonne as Assistant General Superintendent of the Orford Copper Company, where again he was responsible for a complete modernization programme.

" Monel ", the white alloy of nickel and copper, owes its discovery in 1905 to Mr. Stanley, who conceived and developed the process for producing the alloy direct from ore without separating the nickel and copper. As General Superintendent of the Orford Works in 1912, Mr. Stanley was in charge of this important source of refined nickel. Under his direction this plant during World War I was successful in substantially stepping up its production to meet war-time demands.

In 1917 he was elected a Director, and in 1918 Vice-President in charge of all operations of the International Nickel Company. When he became President in 1922, on the death of W. A. Bostwick, the nickel industry was at its lowest ebb. One of the initial efforts of Mr. Stanley was the formation of a Development and Research Division, through which thousands of commercial peace-time applications for nickel were established. Thus began probably the most vital phase of growth in the nickel industry. To spur on an increasing demand for nickel, Mr. Stanley arranged for the construction at Huntington, West Virginia, of a large modern rolling mill exclusively devoted to high nickel products ; he inaugurated a comprehensive mine and plant expansion in

Canada and developed the Frood Mine at Sudbury into one of the world's largest mines.

Following the acquisition of The Mond Nickel Company, Ltd., Mr. Stanley continued as President and assumed chairmanship of the Board of Directors on the death of Charles Hayden in 1937.

Again in World War II, Mr. Stanley was responsible for greatly increasing nickel production for its many vital war uses. Soon after the war started, he arranged for extensive expansion of the Company's Canadian mining production, through which a materially increased supply of nickel, copper, and other products was made available to the United Nations in the crucial war years.

Mr. Stanley's achievements in the nickel industry have brought to him the award of the Thomas Egleston medal presented by Columbia Engineering Schools Alumni Association, the award of the first gold medal of the Rand Foundation by the American Institute of Mining and Metallurgical Engineers, and the American Society for Metals' medal for the Advancement of Research, while in 1937 the King of Belgium conferred upon him the Order of Leopold. In September 1947 Mr. Stanley was awarded the "King's Medal for Service in the Cause of Freedom". This medal was instituted by King George in 1945 "for Civilian Services to the Allied Cause". He has also been awarded the degrees of Sc.D. of Columbia University and the D.Eng. degree of the Stevens Institute of Technology and of the Rensselaer Polytechnic Institute.

In addition to his responsibilities with the International Nickel Company, Mr. Stanley is a Director of the Chase National Bank of the City of New York, the American Metal Company, Ltd., the United States Steel Corporation, the General Electric Company, the Amalgamated Metal Corporation, Ltd. (London), the Babcock and Wilcox Company, the Canadian Pacific Railway Company, the Economic Club of New York, and Henry Gardner and Company, Ltd. (London). He is also Chairman of the Board of Trustees of the Stevens Institute of Technology; Vice-Chairman of the Board of Trustees of the National Safety Council; Treasurer and Trustee of the Malcolm Gordon School; Trustee of the Mutual Life Assurance Company of New York; Member of Council of the Copper Development Association (London), and member of the Governing Body of the International Chamber of Commerce.

Mr. Stanley was elected an Ordinary Member of the Institute in 1928.

PERSONAL NOTES

Mr. H. J. Axon, B.Met., has been awarded the degree of D.Phil.

Mr. Louis Badone, B.Sc., A.R.S.M., L.I.M., who was formerly employed by James Booth and Co., Ltd., has emigrated to Canada.

Mr. R. O. Bearcroft is now at the Aluminium Union, Ltd., The Adelphi, Strand, London, W.C.2.

Mr. W. R. Berry, M.Sc., M.I.Mech.E., F.R.I.C., F.I.M., recently resigned from the Board of Messrs. Ibbotson Brothers, Ltd., Globe Steel Works, Sheffield, and from his appointment as Chief Development Engineer to the Whitehead group of companies. He has opened a practice as Consulting Engineer and Metallurgist at Grey Garth, Wynmore Avenue, Bramhope, near Leeds.

Mr. H. Bootman has left the Department of Research and Technical Development, Messrs. Stewarts and Lloyds, Ltd., Bilston, Staffs., to take up an appointment as Metallurgist in charge of melting and refining with H. J. Enthoven and Sons, Ltd., Darley Dale Works, South Darley, Matlock, Derbyshire.

Mr. S. W. Cadden has been appointed Managing Director of the Tomey Group of Companies, Birmingham.

Mr. A. G. Colley has relinquished his directorship of the Parkinson Stove Company, Ltd., and Monitor Engineering and Oil Appliances, Ltd., owing to the pressure of other business.

Mr. B. D. Cullity, B.Eng., M.S., was recently awarded the degree of Sc.D. in Metallurgy of the Massachusetts Institute of Technology. He is at present engaged on research in physical metallurgy at the Centre de Recherches Métallurgiques de l'École Nationale Supérieure des Mines, 60 boul. St.-Michel, Paris 6e, France.

Mr. Roger A. Day, who graduated last June from Sheffield University with 2nd Class Honours (1st Division) in the degree of B.Met. (Non-Ferrous) has taken up an appointment with the Ministry of Supply at Rocksavage, Cheshire.

Dr. George Drever, B.Sc., has taken up an appointment with Barr and Stroud, Ltd., Anniesland, Glasgow, W.3.

Mr. John O. Edwards, M.Sc., A.I.M., has relinquished his position with The British Aluminium Company, Ltd., to take up an appointment as metallurgist with the Mineral Dressing and Metallurgy Division of the Bureau of Mines, 568 Booth St., Ottawa, Ont., Canada.

The Right Hon. the Viscount Falmouth has been elected Chairman of the Imperial College of Science and Technology, in succession to the late Lord Rayleigh.

Mr. V. C. Faulkner has been elected President, for 1948, of the International Committee of Foundry Technical Associations.

Mr. John Fry, who founded the business in 1912, is retiring from the position of Chairman and Managing Director of Fry's Metal Foundries, Ltd.

Mr. P. N. Gandhi, B.Sc., has left Bombay and is now at the Metallurgical Department, Tata Iron and Steel Company, Ltd., Jamshedpur, Bihar, India.

Mr. G. W. Gibson has been appointed Managing Director of Fry's Metal Foundries, Ltd.

Mr. N. J. Griffiths has been appointed Works Manager at the Brownhills Works of Cindal Aluminium, Ltd., Lichfield Rd., Brownhills, Staffs.

Mr. H. J. Henbrey has resigned from the Board of Directors of Paramount Alloys, Ltd., Slough, in order to join the Boards of two new stainless steel companies in London and Vancouver, B.C., Canada. Mr. Henbrey has recently removed to 57 Watcombe Road, Bournemouth, and expects to visit Canada and Portland, Ore., U.S.A., in March next.

Mr. R. W. K. Honeycombe, M.Sc., has been awarded an Imperial Chemical Industries Fellowship at Cambridge University. He will work at the Cavendish Laboratory with Dr. E. Orowan. He left Australia for England in December, during which month he married Miss June Collins, a fellow graduate of the University of Melbourne.

Mr. James T. Kemp, B.S., Met.E., has left Waterbury and his address is now c/o The American Brass Company, 235 Montgomery St., San Francisco 4, Cal., U.S.A.

Mr. O. Z. Klopsch, B.S., Met.E., is now with the Phelps Dodge Copper Products Corporation, 6100 Garfield Avenue, Los Angeles 22, Cal., U.S.A.

Mr. H. O. Ludkey has left B. K. L. Alloys, Ltd., Kings Norton, Birmingham, to take up the post of Manager of the Aluminium Melting Works, Aerlec (Aluminium), Ltd., Stoke Prior, Bromsgrove, Staffs.

Mr. P. C. N. Majumdar, B.Sc., A.I.M., has left Jaipur and is now Chief Metallurgist to Messrs. Kamani Metals and Alloys, Ltd., Kurla, Bombay Suburb, India.

Mr. Edward T. Mann has changed his address to 42 Avenue Road, Prospect, Adelaide, South Australia. He has given up his appointment with Ronaldson Brothers and Tippett Pty., and for the next two years will be studying at the University of Adelaide.

Captain I. Minkoff, B.Sc., who was released from H.M. Forces in August last, is now employed in the Metallurgical Laboratory of the De Havilland Aircraft Company.

Mr. H. M. Myers, Production Manager, Imperial Chemical Industries, Ltd., Metals Division, Birmingham, was awarded the M.B.E. in the New Year's Honours List.

Mr. D. P. C. Neave, M.A., has left England for a visit to Australia, and expects to return in April.

Mr. W. A. C. Newman, B.Sc., A.R.S.M., A.R.C.S., Chemist and Assayer to the Royal Mint was awarded the O.B.E. in the New Year's Honours list. He is Honorary Treasurer of the Institute.

Dr. E. Orowan, F.R.S., has been appointed Reader in Metal Physics at Cambridge University.

Mr. R. Nicholson Parkins, B.Sc., has been appointed Lecturer in Metallurgy at King's College, Newcastle.

Mr. P. M. Parish has been appointed Chairman of Fry's Metal Foundries, Ltd.

Mr. A. L. Pendrey, B.Sc., has relinquished his position as Manager to the Neptune Brass and Copper Co., Ltd., to take up a post with Sanbra, Ltd., of Birmingham.

Dr. L. B. Pfeil, O.B.E., delivered one of the weekly talks in the B.B.C. series " Science Survey " on 22 January. His subject was " Nickel ".

Professor A. M. Portevin has been elected an Honorary Member of the Association des Ingénieurs de l'Ecole de Louvain. The great esteem in which Professor Portevin is held in Belgium is indicated by the fact that he is already an Honorary Member of the Association des Ingénieurs de l'Université de Liège and the Association des Ingénieurs de Mons, and a Doctor, *honoris causa*, of Brussels University.

Mr. J. A. Rabbitt is now in China. His address is c/o I.C.I. (China), Ltd., 133 Szechuen Road, Shanghai.

Mr. N. W. Read, B.Sc., has left Messrs. David Brown and Sons, Ltd., Huddersfield, to become Technical Officer (Metallurgist), in the Metallurgical Section, Engineering Department, Imperial Chemical Industries, Ltd., Dyestuffs Division, Hexagon House, Blackley, Manchester 9.

Mr. J. M. Reid, B.Sc., has been transferred from the Research Department, Imperial Chemical Industries, Ltd., Metals Division, Witton, to undertake development work at the Landore, Swansea, works of the Company.

Mr. D. R. Rexworty, B.Sc., A.R.I.C., has been appointed Chief Editor and head of Butterworth's Scientific Publications, Ltd., with effect from 1 January. He will continue his duties as Editor of *Research*.

Mr. Stanley Robson, M.Sc., D.I.C., left England for Australia in January and expects to return by the early part of April.

M. Paul Rocquet has left J. J. Carnaud et Forges de Basse-Indre, Billancourt, and is now Chef du Departement de Chimie à l'Irsid, 56 rue de Marechal Joffre, St. Germain-en-Laye, France.

Mr. F. W. Rowe, B.Sc., has been elected Vice-Chairman of the British Steel Founders Association.

Mr. R. C. Williams has changed his business address to New Metals and Chemicals, Ltd., 16 Northumberland Avenue, London, W.C.2.

Mr. D. R. Wood, B.A., L.I.M., has left the Northern Aluminium Company, Ltd., Rogerstone, Newport, to join the Research Laboratories, The Mond Nickel Company, Ltd., Wiggin Street, Birmingham.

Dr. M. R. J. Wyllie, B.Sc., has left Johns Hopkins University and is now with the Gulf Research and Development Company, P.O. Drawer 2038, Pittsburgh 30, Pa., U.S.A.

DEATHS

The Editor regrets to announce the deaths of the undermentioned members :

CLIFTON. On 29 December 1947, Mr. John Christopher Clifton, F.I.M., Chief Metallurgist, Vickers-Armstrong, Ltd., Crayford, Kent.

GRIFFIN. On 12 November 1947, as the result of a motor accident, Mr. Ronald Ernest Griffin, Technical Assistant, Imperial Chemical Industries, Ltd., Metals Division, Witton, Birmingham.

YATES. On 24 September 1947, Mr. George Yates, sole proprietor of Messrs. Daniel Miller and Co., Dublin.

LOCAL SECTIONS NEWS

BIRMINGHAM LOCAL SECTION

The President (Colonel P. G. J. Gueterbock), accompanied by the Secretary, will visit the Section on Thursday, 26 February 1948, when Mr. C. A. H. Jahn will read a paper on " The Metallurgy of Gold, Silver, and Platinum ", at the Latin Theatre, The University, Edmund Street, Birmingham and *not* at the James Watt Memorial Institute, Great Charles Street, as previously published, at 6.30 p.m.

SCOTTISH LOCAL SECTION

The following additional meetings have been arranged :

Mon., 8 *March.*

Visit to the works of Messrs. G. and J. Weir, Ltd., Engineers, Cathcart, Glasgow. (2.30 p.m. at the works.)

Mon., 12 *April.*

Mr. Edwin Davis : " The Mechanical Working of Non-Ferrous Metals ". (Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2, at 6.30 p.m.)

UNIVERSITY NEWS

ROSENHAIN CLUB OF MELBOURNE

The club is sponsoring an annual Rosenhain Memorial Lecture, and Professor J. Neill Greenwood has been invited to deliver the first lecture during the winter of this year.

UNIVERSITY OF BIRMINGHAM METALLURGICAL SOCIETY

The annual dinner of the Society will be held at the White Horse Hotel, Congreve Street, Birmingham, on Saturday, 24 April.

Professor D. Hanson has now completed 21 years in the Chair of Metallurgy at the University, and it is felt that this event should be the occasion of a reunion of old students and former members of the staff of the Metallurgical Department. The dinner is therefore being held on a larger scale than usual, and a Saturday

has been chosen to give the greatest opportunity to past members of the Department to attend.

Those interested should get in touch with Mr. J. O. H. Varley, Secretary of the Society, at the University, or with Mr. E. H. Bucknall, M.Sc., at The Research Laboratory, The Mond Nickel Company, Ltd., Wiggin Street, Birmingham.

OTHER NEWS

MOND NICKEL FELLOWSHIPS: AWARDS FOR 1947

The Mond Nickel Fellowships Committee has made awards as follows for 1947:

(1) WALKER, L. H. To study the methods of application of group industrial research, particularly in relation to the fabrication of light metals.

(2) DAVIES, D. R. G. To study the application of statistical methods to plant metallurgical and management problems, with particular reference to the steel industry.

INTERNATIONAL CONFERENCE ON SURFACE REACTIONS

The Pittsburgh International Conference on Surface Reactions will be held at the Mellon Institute for Industrial Research, Pittsburgh, Pa., U.S.A., from 7 to 11 June 1948.

The Conference Committee consists of: Dr. Earl Gulbransen (Westinghouse Research Laboratories), Chairman, representing the Electrochemical Society, Pittsburgh Section; Prof. D. S. McKinney (Carnegie Institute of Technology) representing the University Conference on Corrosion and Metal Protection; Prof. Mars Fontana (Ohio State University) representing the Electrochemical Society, Corrosion Division; J. M. Bialosky (Research Laboratory, Carnegie–Illinois Steel Company) representing the National Association of Corrosion Engineers; Dr. J. W. Hickman (Westinghouse Research Laboratories) representing the Pittsburgh Physical Society; C. Pogocar (Mellon Institute for Industrial Research) representing the American Society for Metals, Pittsburgh Chapter; Dr. George H. Young (Mellon Institute for Industrial Research) representing the American Chemical Society, Pittsburgh Section; Richard Rimbach (Corrosion Publishing Company) representing the Corrosion Forum.

Preliminary plans call for technical sessions, mornings and evenings, and visits to Pittsburgh research laboratories, which are working on surface reactions, in the afternoons.

Scientists, engineers, and educators from many parts of the world have been invited to participate in the Conference, and several will present papers.

CONGRÈS INTERNATIONAL DES FABRICATIONS MÉCANIQUES

The Syndicat Général des Industries Mécaniques et Transformatrices des Métaux has taken the initiative in organizing this congress in Paris for four days at the beginning of October 1948. As the counterpart of this Syndicat in the United Kingdom, the British Engineers' Association, 32 Victoria St., London, S.W.1,

has been asked to handle arrangements in this country. Attendance at the Congress will not be restricted to members of the Association.

Papers to be presented to the congress will not be concerned with historical surveys; it is hoped to show the developments since 1939 in the concept of manufacture in the mechanical engineering field and of the processing methods for materials (forming, cutting, mechanical finishing, heat-treatment, and anti-corrosive methods).

NATIONAL COUNCIL TO ADVISE ON EDUCATION FOR INDUSTRY AND COMMERCE: WORKING PARTY RECOMMENDATION

The report of the working party set up in September last by Mr. George Tomlinson, the Minister of Education, to report on the establishment of a National Council of Technology, has been published (H.M. Stationery Office, price 2*d*.).

The working party recommend that steps should be taken with as little delay as possible, to establish a National Council on Education for Industry and Commerce to advise the Minister on the national policy necessary for the full development of education in this sphere, stating: "at this time, as never before, there is a real need for well-trained craftsmen, technicians, technologists, scientists, research workers, and managers. Such training calls for careful and concerted planning, and it is evident that a national body is needed to give informed advice in order that development may proceed along sound lines."

It is suggested that the functions of the Council should include: the planning of new developments including National Colleges; expansion of existing facilities; improvement of accommodation and equipment; development of research in colleges; methods of examination and certification of studies; provision of scholarships and awards; preparation of reports; and the co-ordination of the work of the Regional Advisory Councils and Regional Academic Boards which have already been set up. It should also maintain contact with industry and commerce and appropriate professional bodies and arrange consultation with the University Grants Committee and other appropriate bodies on matters relating to education of university standard.

The working party recommend that the proposed Council should be composed of representatives of the local education authorities, university institutions, teachers, employers, and employees in each of the ten regions, together with a number of persons nominated by the Minister to ensure a proper balance of the various interests. It would be necessary for the Council to appoint a Standing Committee to deal with detailed problems. For matters requiring specialized and expert consideration, Advisory Committees should be appointed to report to the Standing Committee.

FOUNDING INDUSTRIES LIAISON COMMITTEE

A Founding Industries Liaison Committee has been established—with Mr. P. H. Wilson, President of the Institute of British Foundrymen, as Chairman, and Mr. T. A. Parkinson as Secretary—as a result of a recent meeting of representatives of the Council of Ironfoundry Associations, the Light Metal Founders' Association, the Association of Brass and Bronze Founders, and the British Steel Founders' Association.

NATIONAL CERTIFICATES IN METALLURGY

The following senior part-time students from the Chance Technical College, Smethwick, passed the final examination for the Ordinary National Certificate: Garratt, Harold Joseph; Greensmith, Joseph Frederick; Hayward, Brian Philip; Moore, Harold; Peyton, Benjamin Alfred; Risbridger, Gerald Arthur; Weavers, Alan Albert; Woodward, Richard Rudolph; Yarnell, Raymond Charles (distinction in chemistry); and York, Arthur John. Mr. R. C. Yarnell was awarded a prize of one guinea, to be taken in books.

B.O.C. WELDING PRIZE

The Council of the British Welding Research Association have gratefully accepted an offer from the British Oxygen Company, Ltd., to provide a prize fund of £100 per annum for three years for a competition relating to welding.

A single prize of £100 is offered in 1948 and will be awarded for the best paper submitted on a research into welding or its application. Papers will require to be submitted on or before 30 September 1948. Full particulars of the competition will be announced shortly.

MR. TOM MAKEMSON

Mr. Tom Makemson, M.B.E., has completed 21 years as Secretary of the Institute of British Foundrymen, though his association with the Institute dates from 1917, when he was elected a member. He became the Honorary Secretary of the Lancashire Branch in 1923.

Trained as a patternmaker at Workington, Mr. Makemson was later employed with the British Westinghouse Company (now Metropolitan-Vickers Electrical Company, Ltd.), Manchester, first as a patternmaker, later in charge of foundry and patternshop apprentice training, and finally in the research department.

Mr. Makemson studied mechanical engineering at the Manchester College of Technology; he then took a course in metallurgy, and was awarded the A.M.T.C. He was appointed Secretary of the Institute of British Foundrymen in 1926, and is also Secretary of the International Committee on Testing of Cast Iron, and of the Manchester Association of Engineers.

In May 1940 he was seconded to the Iron and Steel Control, becoming successively Deputy Director, Joint Director, and then Director for Iron Castings, a post which he relinquished in July 1946. He was awarded the M.B.E. in January 1946. Mr. Makemson has for many years been a Member of Council of the British Cast-Iron Research Association.

ALUMINIUM CONSTRUCTION FOR SCHOOLS: EXHIBITION

Arranged by the Bristol Aeroplane Co. (Housing), Ltd., a private exhibition, held for Local Education Authorities and County Architects, was held in the Central Hall, Westminster, London, S.W.1, on 19 January. The Minister of Education visited the exhibition in the afternoon.

NEWS AND ANNOUNCEMENTS

MECHANICAL HANDLING EXHIBITION

The first National Mechanical Handling Exhibition and Convention, organized by the journal *Mechanical Handling*, will be held at Olympia, London, from 12 to 21 July next.

"DESIGN WEEKS" 1948

The Council of Industrial Design, in co-operation with the Federation of British Industries, the Association of Chambers of Commerce, and with the full support of the Civic Authorities, has now completed the preliminary plans for the three Design Weeks to be held in 1948 which form part of a series that will be held in the leading industrial centres of the country.

During 1948, Design Weeks will be held in Cardiff from 12 to 17 April, in Manchester from 21 to 26 June, and in Birmingham from 11 to 16 October. It is hoped to hold Design Weeks in Bradford and other cities in 1949.

B.I.O.S. OVERALL REPORTS

The Board of Trade, which is responsible for B.I.O.S., has approached experts in the various major technical fields and has asked them to give critical summaries of the data on the detail of German Scientific and Industrial Techniques which have been collected by B.I.O.S., F.I.A.T., and C.I.O.S.

All subjects have now been covered and the critical reports will be known as "B.I.O.S. Overall Reports". There will be 50 of them, all of which are expected to be printed by the end of June this year (1948). The Commonwealth of Australia has also contributed to some of these reports. Among the subjects included is the metal industry.

Advance copies of these reports can be ordered from H.M. Stationery Office, P.O. Box 569, London, S.E.1. All *enquiries* on this subject should be addressed directly to the Board of Trade, T.I.D.U., Research Section, 40 Cadogan Square, London, S.W.1.

ZINC ALLOY GEARS: COMMERCIAL APPLICATIONS

The Zinc Alloy Die-Casters' Association, Lincoln House, Turl Street, Oxford, has published a booklet, obtainable free of charge, on "The Commercial Applications of Zinc Alloy Gears", which directs attention to the advantages of modern pressure die-casting in the quantity production of gears in the light and medium engineering fields.

The properties and design of the gears are described and illustrated, and comparisons are made between zinc alloy and other gear metals. There are further comments on the necessary specifications for zinc alloy, and advice on lubrication.

WAR-TIME ISSUES OF FOREIGN SCIENTIFIC AND TECHNICAL PERIODICALS

A catalogue, dated October 1947, of "Facsimile Reprints of 132 Foreign [non-American] Scientific and Technical Periodicals Published during the War Years", and Catalogue No. 6, of "600 Foreign Scientific and Technical Books and Sets Reproduced by License of the Office of Alien Property", are obtainable from Edwards Bros., Inc., Ann Arbor, Mich., U.S.A.

DIARY FOR MARCH

THE INSTITUTE

Annual General Meeting, Tuesday, Wednesday, and Thursday, 16, 17, and 18 March. (Institution of Civil Engineers, Great George St., London, S.W.1. For details see p. 18.)

LOCAL SECTIONS MEETINGS

Birmingham Local Section.—Mr. F. Hudson: "Precision Casting", illustrated by a film. (James Watt Memorial Institute, Great Charles St., Birmingham, Thursday, 4 March, at 6.30 p.m.)

Birmingham Local Section.—Mr. F. Denaro: "The Metallurgy of Alloy Steel Welding". (James Watt Memorial Institute, Great Charles St., Birmingham, Thursday, 25 March, at 6.30 p.m.)

London Local Section.—Major C. J. P. Ball, D.S.O., M.C.: "The Manufacture and Usage of Magnesium and its Alloys". Joint meeting with the London Section of the Society of Chemical Industry. (Chemical Society, Burlington House, Piccadilly, London, W.1, Monday, 1 March, at 6.30 p.m.)

Scottish Local Section.—Visit to the works of G. and J. Weir, Ltd., Engineers, Cathcart, Glasgow. (Monday, 8 March; 2.30 p.m. at the works.)

Sheffield Local Section.—Mr. J. F. B. Jackson, B.Sc.: "Centrifugal Castings". Joint meeting with the Sheffield Section of the National Trades Technical Societies. (Mining Lecture Theatre, Department of Applied Science, The University, St. George's Square, Sheffield, Friday, 19 March, at 7.30 p.m.)

Swansea Local Section.—Lecture on "Continuous Casting". (Y.M.C.A., Swansea, Tuesday, 9 March, at 6.30 p.m.)

OTHER MEETINGS

MONDAY, 1 MARCH

Cleveland Institution of Engineers.—A. J. Kesterton: "Metallurgical Load as a Factor in Basic Open-Hearth Practice". (Cleveland Scientific and Technical Institution, Corporation Rd., Middlesbrough, at 6.30 p.m.)

TUESDAY, 2 MARCH

Electrodepositors' Technical Society.—H. Silman: "The Motor Car *versus* the Weather". Joint meeting with the Automobile Division of the Institution of Mechanical Engineers. (Geisha Café, Coventry.)

Institute of the Motor Industry, Scarborough Centre.— — Brown: "Oxy-Acetylene Welding for the Use of Vehicle Maintenance in All Aspects". (Lecture Room, Public Library, Scarborough, at 7.30 p.m.)

Institution of Structural Engineers.—D. W. Portus: "Structural Engineering in Chemical Manufacture". (Cleveland Scientific and Technical Institution, Corporation Rd., Middlesbrough, at 6.30 p.m.)

WEDNESDAY, 3 MARCH

Birmingham University Metallurgical Society.—Visit to the Incandescent Heat Co., Ltd., Smethwick.

Institute of Fuel, Midland Section.—Professor N. L. Oliphant: "Atomic Energy as an Alternative to Fuel". (James Watt Memorial Institute, Great Charles St., Birmingham, at 2.30 p.m.)

Institution of Structural Engineers, Wales and Monmouthshire Branch.—R. G. Braithwaite: "Some Problems in the Design of Welded Steel Structures". (Mackworth Hall, Swansea, at 6.30 p.m.)

Institution of Works Managers.—W. B. D. Brown (Glacier Metal Co., Ltd.) and A. K. Rice (Industrial Welfare Society): Half-day conference on "Industrial Discipline and Incentives". (Waldorf Hotel, Aldwych, London, W.C.2, at 12.30 p.m.)

Manchester Metallurgical Society.—E. Mills: "Metallurgical Problems Arising from the Use of Non-Ferrous Metals in the Telecommunication Industry". (Engineers' Club, Albert Sq., Manchester, at 6.30 p.m.)

THURSDAY, 4 MARCH

Chemical Society.—Professor E. G. Cox: "Crystallographic Technique and its Chemical Significance". Tilden Lecture. (Chemistry Lecture Theatre, The University, Liverpool, at 4.30 p.m.)

Institute of Welding.—S. M. Reisser: "The Design and Construction of Welded Buildings of the Portal Frame Type". (Cleveland Scientific and Technical Institution, Corporation Rd., Middlesbrough, at 7.30 p.m.)

Institute of Welding, South London Branch.—H. N. Pemberton: "The Design, Construction, and Testing of Welded Pressure Vessels". (Institute of Marine Engineers, 85–88 The Minories, London, E.C.3, at 6.30 p.m.)

Leeds Metallurgical Society.—Dr. A. T. Bowden: "Gas Turbine Applications in Iron and Steel Works". Joint meeting with the Iron and Steel Institute. (Main Lecture Theatre, Chemistry Dept., The University, Leeds, at 7 p.m.)

Royal Institution.—Professor Sir Lawrence Bragg, F.R.S.: "Current Research Work in the Cavendish Laboratory". First of three Lectures. (The Institution, 21 Albemarle St., London, W.1, at 5.15 p.m.)

FRIDAY, 5 MARCH

North-East Coast Institution of Engineers and Shipbuilders.—W. Muckle: "Resistance to Buckling of Light Alloy Plates and Some Experiments on a Model Superstructure". (Mining Institute, Newcastle-on-Tyne, at 6.15 p.m.)

SATURDAY, 6 MARCH

Institute of British Foundrymen, Bristol and West of England Branch.—D. Robertson: "Loam and Dry Sand Moulding". (Rougemont Hotel, Exeter, at 3 p.m.)

Institute of British Foundrymen, West Riding of Yorkshire Branch.—Brains Trust. (Technical College, Bradford, at 6.30 p.m.)

MONDAY, 8 MARCH

Institute of British Foundrymen, Sheffield Branch.—D. A. Chaytor: "A Modern Method of Foundry Planning". (Royal Victoria Hotel, Sheffield, at 7.30 p.m.)

TUESDAY, 9 MARCH

Institute of British Foundrymen, Burnley Section.—Annual General Meeting. — Greenwood: "Foundry Casting". (Burnley Municipal College, Ormerod Rd., Burnley, at 7.30 p.m.)

Institution of Engineers and Shipbuilders in Scotland.—Dr. L. Mullins: "Shipbuilding Radiography". (39 Elmbank Crescent, Glasgow, C.2, at 6.30 p.m.)

Institution of Works Managers, Liverpool Branch.—F. J. Burns Morton: "Foremanship". (Exchange Hotel, Liverpool, at 6.45 p.m.)

WEDNESDAY, 10 MARCH

Institute of British Foundrymen, East Anglian Branch.—A. J. Richman: "Some Interesting Developments in Foundry Production". (Lecture Hall, Central Library, Ipswich, at 7.30 p.m.)

Institute of British Foundrymen, Lancashire Branch.—F. J. Tector, B.Eng., and J. Martland: "Foundry Practice in a Large Works Manufacturing Marine Propellers". (Engineers' Club, Albert Sq., Manchester, at 7 p.m.)

Society of Instrument Technology.—L. Morley: "Differential Analysers"; A. Robertshaw: "Instrumentation in Analytical Control of Foundry Production". (Cleveland Scientific and Technical Institution, Corporation Rd., Middlesbrough, at 7.30 p.m.)

THURSDAY, 11 MARCH

Institution of Electrical Engineers, Installations Section.—W. Bowen: "Factors Governing Specifications for Flexible Electric Cables". (The Institution, Savoy Place, Victoria Embankment, London, W.C.2, at 5.30 p.m.)

Royal Institution.—Professor Sir Lawrence Bragg, F.R.S.: "Current Research Work in the Cavendish Laboratory". Second Lecture. (The Institution, 21 Albemarle St., London, W.1, at 5.15 p.m.)

FRIDAY, 12 MARCH

Institute of British Foundrymen, Middlesbrough Branch.—C. A. Payne: "Cupola Operation—Precept and Practice". (Cleveland Scientific and Technical Institution, Corporation Rd., Middlesbrough, at 7 p.m.)

Institute of Fuel, South Wales Section.—Dr. H. R. Fehling: "Data on Combustion with Oxygen and Oxygen-Enriched Air. Part I.—Thermodynamic Data and their Implications in High-Temperature Heating Processes". (Guildhall, Swansea, at 6 p.m.)

Institution of Works Managers, Manchester Branch.—Dr. N. S. Ross: "Management and Employee Relationships". (Engineers' Club, Albert Sq., Manchester, at 6.30 p.m.)

SATURDAY, 13 MARCH

Institute of British Foundrymen, Newcastle Branch.—Visit to the Wallsend Works of the North-Eastern Marine Engineering Co., Ltd.

Institute of British Foundrymen, Scottish Branch.—Annual Business Meeting. R. C. Shepherd: "The Influence of Production Flow on Moulding Methods in Iron Foundries and its Effect on P.M.H. and General Efficiency". (Royal Technical College, George St., Glasgow, at 2.45 p.m.)

MONDAY, 15 MARCH

Electrodepositors' Technical Society.—Dr. S. Wernick: "Electropolishing". (Northampton Polytechnic, St. John St., Clerkenwell, London, E.C.1, at 5.30 p.m.)

Sheffield Society of Engineers and Metallurgists.—Dr. C. H. Desch, F.R.S.: "The Cold-Working of Metals". (Royal Victoria Station Hotel, Sheffield, at 6.15 p.m.)

TUESDAY, 16 MARCH

Institute of the Motor Industry, London Centre.—R. J. Brown: "Failures of Materials in Service". (Bridge House Hotel, 4 Borough High St., London Bridge, London, S.E.1, at 8 p.m.)

Royal Society of Arts, Dominions and Colonies Section.—Dr. E. Marsden, C.M.G., C.B.E., M.C., F.R.S.: "Co-ordination of Research in the Pacific". (The Society, John Adam St., Adelphi, London, W.C.2, at 2.30 p.m.)

WEDNESDAY, 17 MARCH

Birmingham University Metallurgical Society.—Visit to Accles and Pollock, Ltd., Oldbury.

British Institution of Radio Engineers, Scottish Section.—Dr. Angus Campbell: "Development of Radiology". (Heriot Watt College, Edinburgh 1, at 6.30 p.m.)

Geological Society of London.—Anniversary Meeting. (Burlington House, Piccadilly, London, W.1, at 5 p.m.)

Institute of the Motor Industry, Maidstone Centre.—P. P. Love: "Bearing Failures—Analysis and Prevention". (Royal Star Hotel, Maidstone, at 7.30 p.m.)

Institute of Welding, West of Scotland Branch.—T. L. Usherwood: "Detailed Design of Welded Structures". (Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2, at 6.45 p.m.)

Manchester Metallurgical Society.—"Modern Heat-Treatment Furnaces". Discussion opened by Mr. R. S. Brown, M.B.E. (Engineers' Club, Albert Sq., Manchester, at 6.30 p.m.)

THURSDAY, 18 MARCH

Institute of British Foundrymen, Lincoln Section.—E. C. Dickinson: "Recent Technical Developments Applicable to the Production of Castings". (Lincoln Technical College, Lincoln, at 7.15 p.m.)

Institution of Mining and Metallurgy. General Meeting. (Geological Society, Burlington House, Piccadilly, London, W.1, at 5 p.m.)

Royal Institution.—Professor Sir Lawrence Bragg, F.R.S.: "Current Research Work in the Cavendish Laboratory". Third, and last, lecture. (The Institution, 21 Albemarle St., London, W.1, at 5.15 p.m.)

Scientific Society of the Royal Technical College, Glasgow.—H. J. Fitzpatrick: "Protection of Inventions". (Royal Technical College, George St., Glasgow, at 7.30 p.m.)

FRIDAY, 19 MARCH

Royal Institution.—Professor Sir Lawrence Bragg, F.R.S.: "Metal Physics." (The Institution, 21 Albemarle St., London, W.1, at 9 p.m.)

West of Scotland Iron and Steel Institute.—R. Duncan: "Casting Pit Practice and Ingot Defects". (Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2, at 6.45 p.m.)

SATURDAY, 20 MARCH

Institute of British Foundrymen, Bristol and West of England Branch.—H. A. Redshaw: "Ferrous Die-Casting." (Grand Hotel, Broad St., Bristol, at 3 p.m.)

Swansea and District Metallurgical Society.—Paper by R. A. Hacking, O.B.E. (Royal Institution, Swansea, at 6.30 p.m.)

MONDAY, 22 MARCH

Institute of Cost and Works Accountants, Students' Society.—W. Troughton: "Rolling Mill Costing". (Cleveland Scientific and Technical Institution, Corporation Rd., Middlesbrough, at 7.15 p.m.)

Institution of Works Managers, Glasgow Branch.—D. G. Petrie: "Production Planning: Output *versus* Paper". (Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C.2, at 7 p.m.)

WEDNESDAY, 24 MARCH

Association of Special Libraries and Information Bureaux.—Users' questions on the Universal Decimal Classification Answered. (Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, at 2.30 p.m.)

THURSDAY, 25 MARCH

Institution of Structural Engineers.—Professor W. Fisher Caissie: "The Torsional Constants of Structural Steel Sections". (11 Upper Belgrave St., London, S.W.1, at 5.55 p.m.)

APPOINTMENTS VACANT

To conform to the requirements of the Control of Engagements Order, 1947, these advertisements are published for the information only of those who are "excepted persons" under the Order.

ALUMINIUM LABORATORIES, LIMITED, Banbury, Oxon., have vacancies for *Research Metallurgists* and *Chemists*, preferably with experience in light alloys. Staff application forms may be obtained from the Director of Research on request.

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION has a vacancy for a *Metallurgist* for the Liaison and Technical Service Department. Applicants must be British and should be graduates or possess equivalent qualifications in metallurgy. They must have had some years' experience in the wrought copper and copper alloy industry and be interested in the application of research results to industrial practice. Commencing salary up to £600 per annum. Reply to the Secretary, 81–91 Euston Street, London, N.W.1.

LARGE ENGINEERING FIRM in Midlands require *Works Metallurgist* with experience in non-ferrous metals, to take charge of a small metallurgical department including X-ray laboratory. Apply stating age, professional qualifications, experience, and salary required, quoting Ref. 88, to Box No. 225, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

LONDON METALLURGICAL SOCIETY requires Senior Editorial Assistant (male) for its publications department. Applications are invited from graduates under 28 years of age with a knowledge of German. Previous editorial experience is not necessary. Salary according to qualifications. Reply to Box No. 226, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

METALLURGICAL ASSISTANT required for Engineering Works in North Midlands; Graduate or Associate preferred; age 20–25 years; previous experience in foundry or welding work desirable, but not essential. The post covers shop and laboratory work and offers wide scope to a man with initiative. Write stating age, experience, and salary required to Box No. 224, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

METALLURGIST. The Tin Research Institute invites applications for a Senior post in the metallurgical department. A special knowledge of bronze alloys and sound scientific education (Ph.D. or equivalent) essential. The duties will include both research and practical development, and full opportunity is given for publishing scientific papers. Salary £800 p.a., or more according to qualifications, plus superannuation under the F.S.S.U. scheme. Applications to be made to the Director, Tin Research Institute, Fraser Road, Greenford, Middlesex.

SENIOR METALLURGIST, aged 30–45, with degree or equivalent qualification and industrial experience, required by long established foundry in the North-West. Salary according to qualifications but approximately £1000 p.a. Box No. 223, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

SOUTH AFRICAN BUREAU OF STANDARDS: CHEMIST-METALLURGIST. Applications are invited from suitably qualified persons for appointment as a technical officer (Metallurgist) in the chemical division of the Bureau. The successful applicant will be required to hold a B.Sc. degree in chemistry or chemical engineering. The officer must be able to assist in the chemical and metallurgical testing of materials and commodities and in the compilation of specifications for commodities and raw materials. Preference will be given to applicants who have had experience in metallography and in the chemical analysis of ferrous and non-ferrous metals and alloys.

Applicants must state their age, marital status, nationality, full details of their scientific, technical, and academic training and experience, and indicate the earliest date on which duties can be assumed. A medical certificate of good health will be required, and the successful applicant will also be required to become a member of the pension fund.

The salary scale is £600 × 30—£840, plus cost of living allowance which is at present £140 per annum for married and £40 per annum for unmarried officers. Ship's fare will be paid by the Bureau.

Air-mailed applications must reach the Secretary of the Bureau, Private Bag 191, Pretoria, South Africa, not later than 31 March 1948. Any further information will be supplied on application.

TIN RESEARCH INSTITUTE desires to appoint a *Senior Investigator* for work on friction and tin base bearings. A sound knowledge of metallurgy with engineering or physics background essential. The duties will include both research and practical development. Full opportunity is given for publishing scientific papers.

Salary £800 p.a. or more according to qualifications, plus superannuation under the F.S.S.U. scheme.

Applications to be made to the Director, Tin Research Institute, Fraser Road, Greenford, Middlesex.

NOTICE TO AUTHORS OF PAPERS

1. **Papers will be considered for publication from non-members as well as from members of the Institute.** They are accepted for publication in the *Journal*, and not necessarily for presentation at any meeting of the Institute, and should be addressed to The Editor of Publications, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

2. **Papers suitable for publication** may be classified as :

   (*a*) Papers recording the results of original research;
   (*b*) First-class reviews of, or accounts of, progress in a particular field;
   (*c*) Papers descriptive of works methods, or recent developments in metallurgical plant and practice.

3. **Manuscripts and illustrations** should be submitted in duplicate. MSS. must be typewritten (*double-line spacing*) on one side of the paper only, and authors are required to sign a declaration that neither the paper nor a substantial part thereof has been published elsewhere. MSS. not accepted are normally returned within 3 months of receipt.

4. **Synopsis.** Every paper must have a synopsis (not exceeding 250 words in length), which, in the case of results of research, should state its objects, the ground covered, and the nature of the results. The synopsis will appear at the beginning of the paper.

5. **References** must be collected at the end of the paper, and must be numbered. Initials of authors must be given, and the Institute's official abbreviations for periodical titles (as used in *Met. Abs.*) must be used where known. References must be set out in the style :

   1. W. Hofmann and W. Jäniche, *Z. Metallkunde*, 1936, **28**, 1 (i.e. year, volume, page).

6. **Illustrations.** Each illustration must have a number and description; only one set of numbers must be used in one paper. The set of *line figures* sent for reproduction must be drawn in Indian ink on smooth white Bristol board, good-quality drawing paper, co-ordinate paper, or tracing *cloth*, which are preferred in the order given. Co-ordinate paper, if used, must be blue-lined with the co-ordinates to be reproduced *finely* drawn in Indian ink. All lettering and numerals, &c., should preferably be in *pencil*. Figures should be drawn approximately twice the size intended for reproduction. *Photographs* must be restricted in number, owing to the expense of reproduction, and trimmed to the smallest possible of the following sizes, consistent with adequate representation of the subject: 3 in. deep by 4 in. wide (two photomicrographs to a plate); 3 in. deep by 2¼ in. wide (four to a plate); 2 in. deep by 2¼ in. wide (six to a plate). Magnifications of photomicrographs must be given in each case. Photographs for reproduction should be loose, not pasted down (and not fastened together with a clip, which damages them), and the figure number should be written on the back of each. Legends should be given to photomicrographs, but lengthy descriptions should be avoided owing to the very limited space available on the plates. Because of restrictions on paper supplies, illustrations that are not *essential* to the appreciation of the paper should not be included. Only in exceptional cases will illustrations be reproduced if already printed and readily available elsewhere.

7. **Tables or Diagrams.** Results of experiments, &c., may be given in the form of tables *or* figures, *but* (unless there are exceptional reasons) *not both*.

8. **Overseas Authors.** Authors resident in countries distant from Great Britain are requested to name, if possible, agents in Britain to whom may be referred matters concerning their papers, including proofs for correction. Translations from foreign languages should preferably be accompanied by a copy of the MS. in the language of the author.

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Name of applicant in full.....

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Qualification .....

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Dated this.....day of....., 19.....

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THE EFFECT OF 1% SILICON ON THE CONSTITUTION OF ALUMINIUM–MAGNESIUM–MANGANESE–ZINC ALLOYS AT 460° C.* 1123

By H. J. AXON,† D.Phil., B.Met., Student Member, and W. HUME-ROTHERY,‡ M.A., D.Sc., F.R.S., Member.

Synopsis.

The constitution of Al–Mg–Mn–Zn–Si alloys containing 1% silicon has been determined for alloys containing 0–6% magnesium, 0–4% manganese, and 0–8% zinc after annealing to equilibrium at 460° C. The work involves the determination of parts of the equilibrium diagram of the various ternary and quaternary systems which are involved in the quinary system. The results are presented graphically in the form of diagrams referring to alloys containing 1% silicon, and 0, 4, and 8% zinc. Interpolation between these diagrams enables the constitution to be read off for any quinary alloy containing 1% silicon together with magnesium, manganese, and zinc within the above-mentioned limits.

I.—Introduction.

The present paper describes experiments on the constitution at 460° C. of quinary § aluminium-rich Al–Mg–Mn–Zn–Si alloys containing 1% silicon, and is an extension of previous work [1,2,3,4,5] on the constitution of alloys of the quaternary system Al–Mg–Mn–Zn. When silicon is added to form a quinary system, the determination of the complete 5-dimensional equilibrium diagram is very laborious, and in the present work the authors have endeavoured to obtain an indication of the general effect of silicon by examining a whole series of alloys containing 1% of silicon after annealing to equilibrium at 460° C., and then comparing the resulting structures with those of the corresponding quaternary Al–Mg–Mn–Zn alloys at the same temperature. This temperature was chosen because it is one which is sometimes used for the heat-treatment of Al–Mg–Mn–Zn alloys; the same temperature has been used for a study [6] of the ternary system Al–Cu–Mg, and of the [7] quaternary system Al–Cu–Mg–Zn, a knowledge of which is required in order to understand the effect of copper on the Al–Mg–Mn–Zn system.

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§ For abbreviation, chemical symbols have been used to describe the systems, because if words are used the description often extends from one line to another, and clarity is lost.

For abbreviation, a symbolism such as alloy $(x, y, z)s$ has been used to denote an alloy containing x% magnesium, y% manganese, z% zinc, and s% silicon.

II.—Experimental Methods and Details.

The aluminium used in the present work was super-purity aluminium supplied by The British Aluminium Company, Ltd., while the magnesium was of 99·98% purity, obtained through the Ministry of Supply. The zinc was of 99·9% purity and was kindly given by The National Smelting Corporation, Ltd. The silicon was introduced in the form of a master alloy containing approximately 11·5% silicon; this master alloy was prepared by The British Aluminium Company, Ltd., to whom the authors must express their thanks.

The alloys were melted under flux in crucibles lined with alumina–fluorspar mixture, and were cast into heavy copper moulds which gave cylindrical ingots $\frac{5}{16}$ in. in diameter. They were then enclosed in sealed evacuated glass tubes which were heated in electric resistance furnaces controlled by Foster temperature regulators. The accuracy of the temperature control was usually of the order $\pm 2°$ C. At the end of the annealing treatment, the alloy was quenched in iced water.

Specimens for microscopic examination were prepared by the methods previously described.[1–5] A metal polish of the "Brasso" type was used, because the Mg_2Si phase is attacked by water.

As will be appreciated from the following sections, the phases met with in the present alloys are comparatively few, and their etching characteristics may be summarized as follows:

The aluminium-rich α-solid solution appears light in polished and unetched sections. On etching with the reagents described below, the α-phase remains as a light background, often with a pale yellow tint, although tarnishing and pitting may occur if the alloy is over-etched.

The Mg_2Si phase of the binary system Mg–Si is found in many alloys. In freshly prepared sections, Mg_2Si has a characteristic blue colour, but in a moist atmosphere this is rapidly destroyed by tarnishing. Mg_2Si is attacked by water and is dissolved out by nearly all aqueous solutions of acids or alkalis. Specimens containing Mg_2Si could be etched satisfactorily by exposure to nitric acid vapour which stains the Mg_2Si an even black-brown, most of the other constituents being left unattacked. For this treatment, the specimen was placed on a glass spoon suspended from the cork of a wide-mouthed bottle containing

a little concentrated nitric acid; an exposure of 30 sec. was found satisfactory.

Silicon. In polished and unetched sections, silicon appears as a hard constituent, of pale-lilac colour, usually in slight relief; the relief effect is greater than for Mg_2Si.

The $MnAl_6$ phase of the binary system Al–Mn appears in the form of flat grey crystals in the unetched sections, and is readily distinguished from the *ternary Al–Mn–Si phase* whose particles are of a characteristic pink-brown colour. This ternary phase was denoted T by Bückle,[8] and it is referred to in the present paper as T_{Si} in order to avoid confusion with the ternary phase in the system Al–Mg–Zn, for which the symbol T has already been used. The T_{Si} particles are usually of irregular rounded shapes, and this characteristic helps in their identification.

More than 60 alloys were analysed for one or more constituents, and the results showed that by the use of strictly standardized melting conditions, the intended compositions were very closely attained. When this point had been established it was felt justifiable to use the intended compositions when plotting the constitutional diagrams, and it is for this reason that some of the diagrams given later involve so few points whose compositions were determined by analysis. It is thought that where analyses were not made, points in the diagrams should not involve errors greater than $\pm 0{\cdot}2\%$ in the magnesium contents, and $\pm 0{\cdot}1\%$ in the silicon, manganese, and zinc contents. The analyses were carried out by Messrs. Johnson, Matthey and Company, Ltd., and the authors must express their thanks to Mr. A. R. Powell for his care and attention. As in the previous work, the analyses were always made on the actual specimens which had been used for microscopic examination.

In the diagrams, full points refer to alloys which have been analysed, and open points refer to the synthetic compositions of alloys which have not been analysed.

III.—Experimental Results: Ternary Alloys.

It is convenient to describe first the results obtained for the ternary alloys, and to discuss these in relation to the work of previous investigators.

1. *The System Aluminium–Magnesium–Silicon.*

The previous work on this system has been reviewed by H. W. L. Phillips,[9] who obtained accurate values for the boundaries of some of the phase fields at 500° and 200° C. The results of the present work

are shown in Fig. 1, which is based on the study of 26 alloys annealed for 14 days at 460° C. The diagram interpolates well between the results at 500° and 200° C. obtained by Phillips. The α-solid-solubility

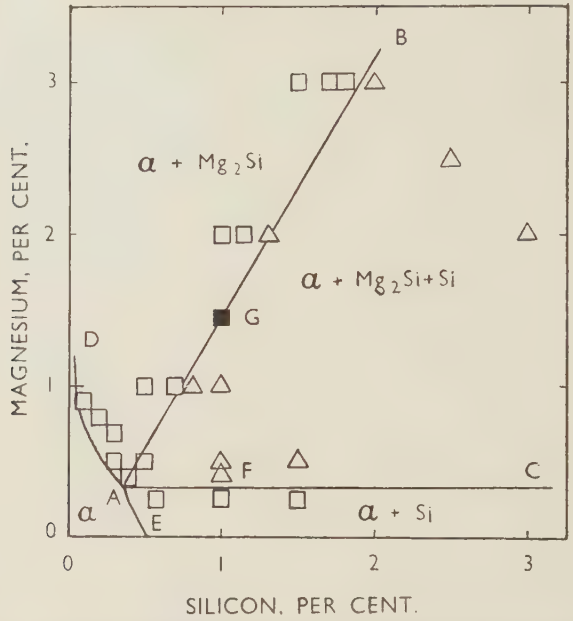

FIG. 1.—The Ternary System Al–Mg–Si. Equilibrium Diagram at 460° C.

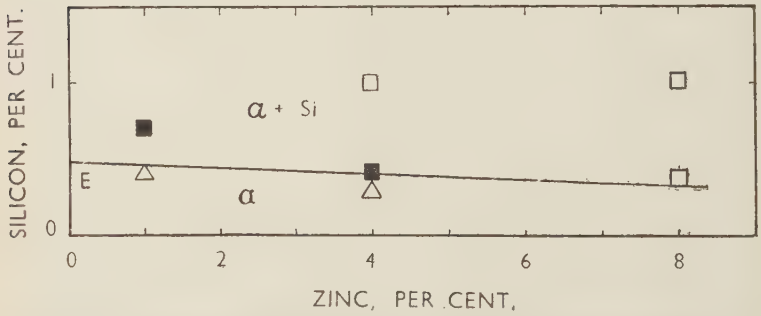

FIG. 2.—The Ternary System Al–Si–Zn. Equilibrium Diagram at 460° C.

curve is divided into two sections, representing equilibrium with silicon and Mg_2Si respectively, and the ($\alpha + Mg_2Si$), ($\alpha + Mg_2Si + Si$), and ($\alpha + Si$) fields lie in a simple sequence. The composition of the point

A, representing the apex of the 3-phase ($\alpha + Mg_2Si + Si$) field is 0·35% magnesium and 0·36% silicon.

For the later diagrams, it is necessary to know the compositions of the points at which the 1%-silicon line in Fig. 1 cuts the lines *AC* and *AB*, and these lie at 0·35 and 1·45% magnesium, respectively (points *F* and *G*).

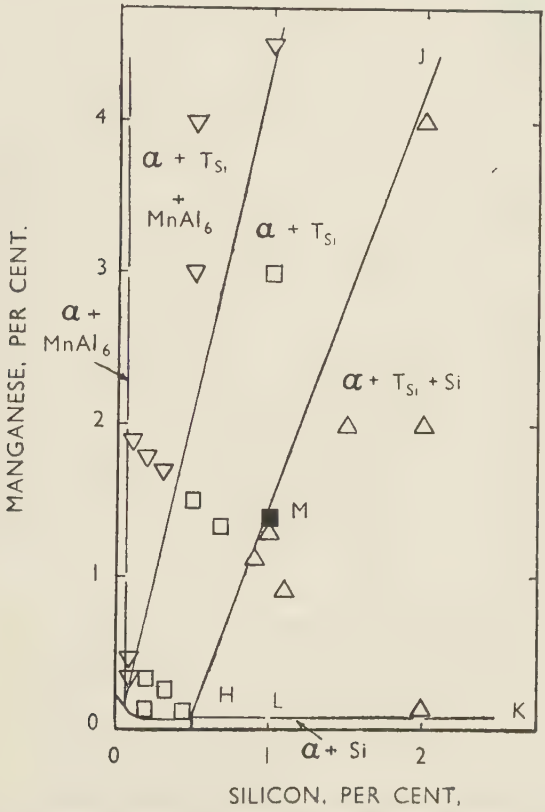

Fig. 3.—The Ternary System Al–Mn–Si. Equilibrium Diagram at 460° C.

2. *The System Aluminium–Zinc–Silicon.*

Fig. 2 shows the aluminium-rich corner of the equilibrium diagram of the ternary system Al–Zn–Si, and is based on the study of 7 alloys which were annealed at 460° C. for 14 days. In the range of composition concerned, the only phases encountered are the α-solid solution and free silicon. According to Dix and Heath,[10] the solubility of silicon in aluminium is 0·5% at 460° C., and this value was confirmed in the present

work, in which an alloy containing 0·51% silicon was found to consist of homogeneous α after annealing for 5 days at 600° C., but precipitated traces of silicon on re-annealing for 14 days at 460° C. : the composition 0·51% silicon was obtained by the analysis of the specimen after the final annealing at 460° C.

The solubility of silicon in aluminium is diminished by the presence of zinc, and with 4·0% zinc the solubility of silicon is about 0·4%. From this it follows that all ternary Al–Zn–Si alloys containing 1% silicon are in the (α + Si) field, and the exact form of the α/α + Si boundary is not required for the drawing of the later diagrams.

3. *The Ternary System Aluminium–Manganese–Silicon.*

The equilibrium diagram of this system has been investigated by Bückle.[8] According to this author, the phases encountered in the region with which the present paper is concerned are the α-solid solution, $MnAl_6$, the ternary (Al–Mn–Si)T_{Si} phase, and silicon; and this has been confirmed by the present work. The results of the present investigation are shown in Fig. 3, which is based on the study of 23 alloys annealed at 460° C. for four weeks. The diagram is almost self-explanatory, and it will be seen that the α, (α + $MnAl_6$), and (α + Si) fields are so restricted that their limits are exceeded by alloys containing as little as 0·1% manganese or 0·13% silicon, with the result that all the alloys prepared lay outside these fields, and the boundaries concerned have been drawn from a careful consideration of the relative amounts of the different phases.

For the construction of the later diagrams, it is necessary to know the points at which the line in Fig. 3 at 1% silicon cuts the lines *HJ* and *HK*, and these are placed at 0·08 and 1·3% manganese, respectively.

IV.—The Quaternary System Aluminium–Magnesium–Zinc–Silicon at 460° C: The 1%-Silicon Section.

The constitution of quaternary Al–Mg–Zn–Si alloys at 460° C. may be represented by the usual tetrahedral model in which the faces of the tetrahedron show the constitution of the four constituent ternary systems. For the present purpose, it is convenient to use a tetrahedron with three mutually perpendicular faces in place of a regular tetrahedron, and the basal plane may be imagined to represent the system Al–Mg–Zn, which is shown in Fig. 4, these results being taken from a previous paper.[7] It will be seen that in the range of composition with which the authors are concerned, the only phases encountered are the α-solid solution and the ternary phase denoted *T*, which is usually regarded

as based on the composition $Al_2Mg_2Zn_3$, although actually its composition varies over a wide range.

The Al–Mg–Si and Al–Zn–Si systems may now be regarded as being represented by the two vertical faces of the tetrahedron, and a section across the tetrahedon at 1% silicon may be considered. The constitutions of the alloys investigated in this section are shown in Fig. 5,

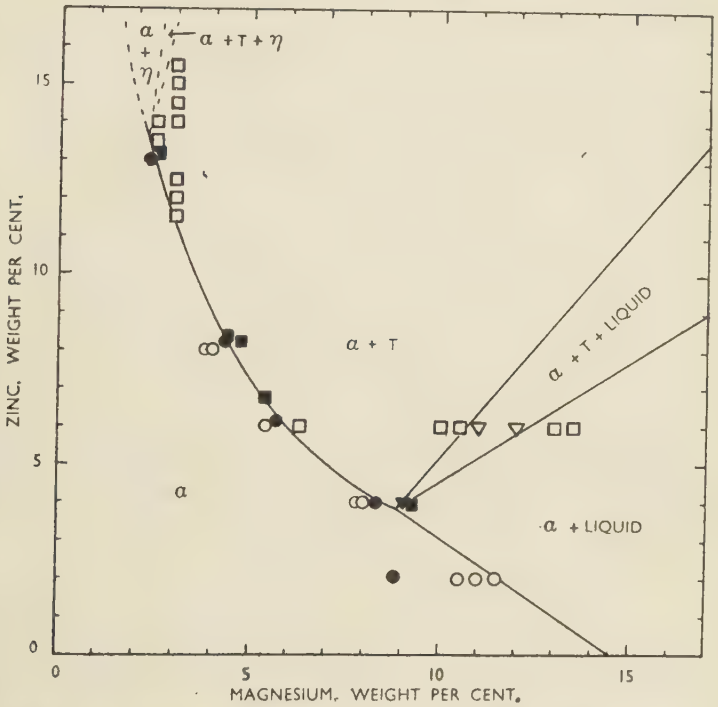

FIG. 4.—The Ternary System Al–Mg–Zn. Equilibrium Diagram at 460° C.

which is based on the study of 30 alloys annealed for 30 days at 460° C. In these alloys, the silicon content of 1% is sufficiently great for the α-solubility limit to be exceeded, with the result that there is no homogeneous α area in Fig. 5. In the aluminium-rich alloys, the (α + Si), (α + Mg_2Si + Si), and (α + Mg_2Si) fields lie in regular sequence with increasing magnesium content. The points *F* and *G*, on the vertical axis of Fig. 5, are taken from the intersections of the line at 1% silicon with the lines *AC* and *AB* in the ternary diagram of the Al–Mg–Si system in Fig. 1.

With higher percentages of magnesium and zinc, alloys of the

($\alpha + Mg_2Si + T$) type are encountered, and the boundary between this 3-phase field and the ($\alpha + Mg_2Si$) field is shown by a full line in

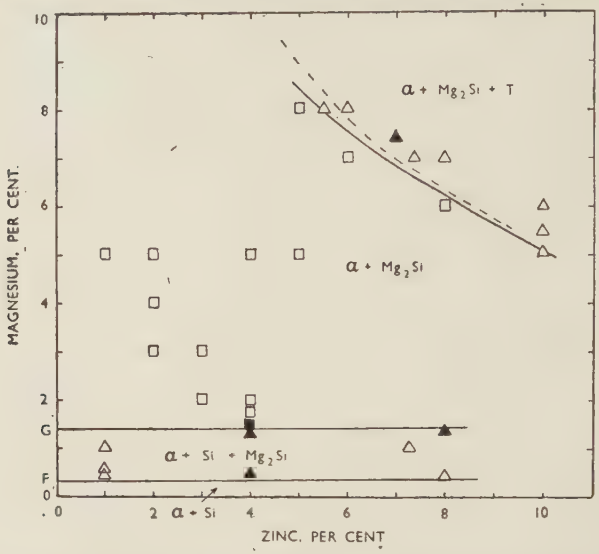

FIG. 5.—The Quaternary System Al–Mg–Zn–Si. Equilibrium Diagram of alloys containing 1% silicon at 460° C. The dotted line shows the boundary between the ($\alpha + Mg_2Si$) and ($\alpha + Mg_2Si + T$) fields, as calculated by the theory described on p. 323, while the adjacent full line shows the actual boundary deduced from the microscopic work.

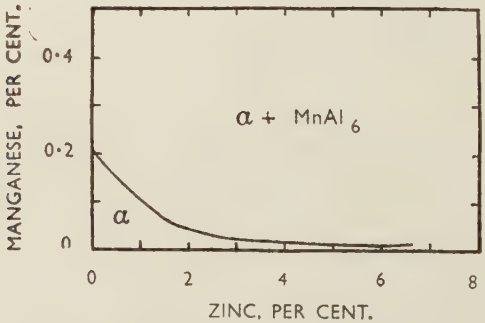

FIG. 6.—The Ternary System Al–Mn–Zn. Equilibrium Diagram at 460° C.

Fig. 5. Comparison with Fig. 4 shows that the ($\alpha + Mg_2Si$)/($\alpha + Mg_2Si + T$) boundary in Fig. 5 lies at higher percentages of zinc and magnesium than the corresponding $\alpha/(\alpha + T)$ boundary in Fig. 4.

This may reasonably be ascribed to the formation of Mg_2Si, since the formation of this compound may be regarded as removing some of the

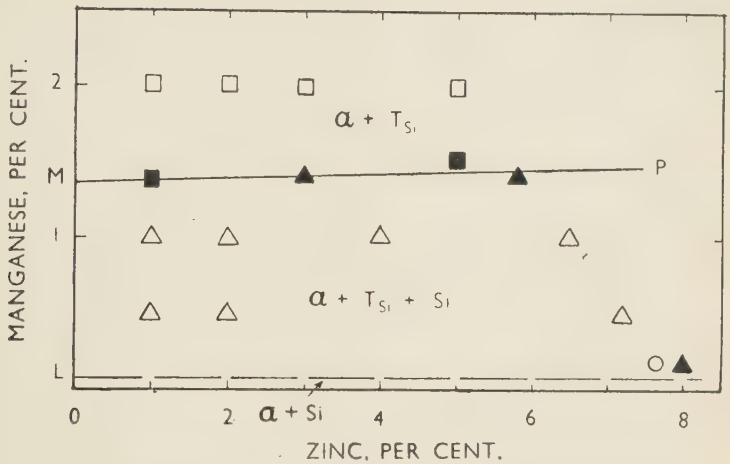

FIG. 7.—The Quaternary System Al–Mn–Zn–Si. Equilibrium Diagram of alloys containing 1% silicon at 460° C.

magnesium from the α-solid solution, and so displacing the $\alpha/(\alpha + T)$ equilibrium in the direction of increasing magnesium content when the latter is expressed as a percentage of the alloy as a whole. If, as a first approximation, it is assumed that each atom of silicon removes two atoms of magnesium and leaves the remaining equilibrium unaltered, the displacement of the $\alpha/(\alpha + T)$ boundary of Fig. 4, which may be expected to give the $(\alpha + Mg_2Si)/(\alpha + Mg_2Si + T)$ boundary in alloys containing 1% silicon may be calculated. This calculated boundary is indicated by dotted lines in Fig. 5, and it will be seen that it is in reasonably good agreement with the facts.

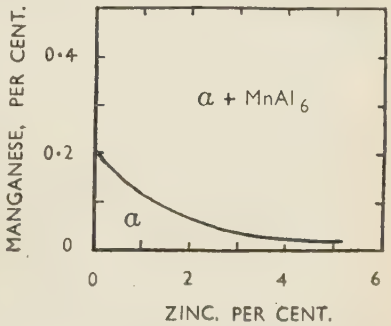

FIG. 8.—The Ternary System Al–Mg–Mn. Equilibrium Diagram at 460° C.

V.—The Quaternary System Aluminium–Manganese–Zinc–Silicon at 460° C.: Alloys Containing 1% Silicon.

As in the preceding section, the constitution of the Al–Mn–Zn–Si alloys at 460° C. may be regarded as being represented by a right-angled tetrahedron, with the Al–Mn–Zn system in the basal plane, and the

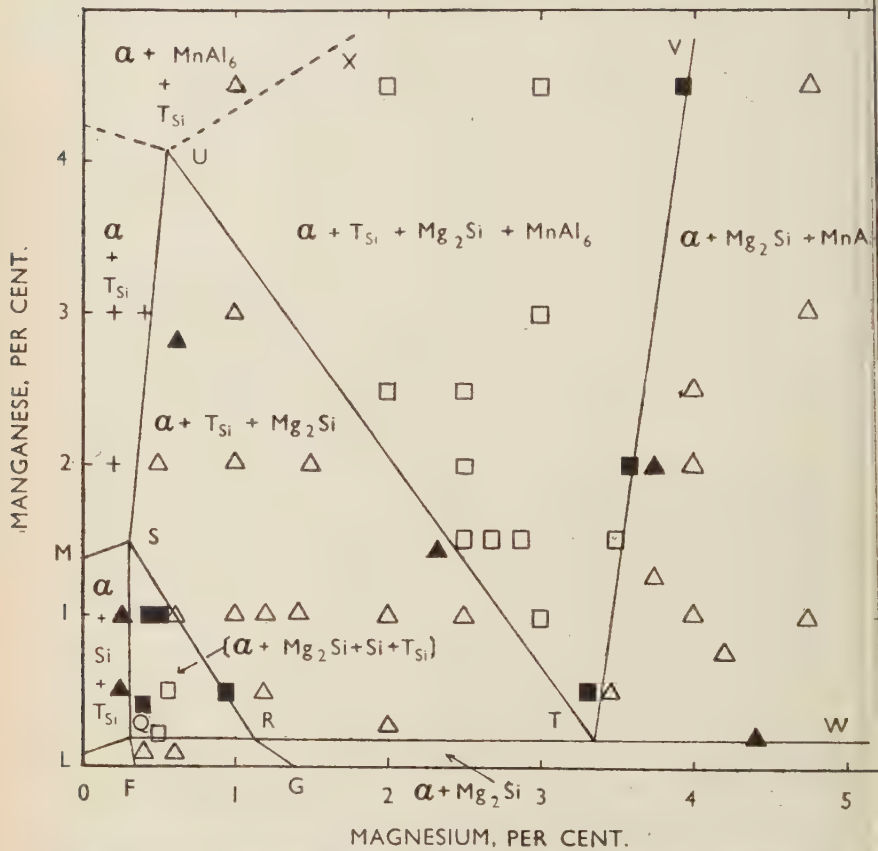

Fig. 9.—The Quaternary System Al–Mg–Mn–Si. Equilibrium Diagram of alloys containing 1% silicon at 460° C.

Al–Mn–Si and Al–Zn–Si systems on the two vertical sides of the tetrahedron. The base of the tetrahedron will then represent the structures of the ternary Al–Mn–Zn alloys at 460° C., and these are shown in Fig 6, which is constructed from a previous paper.[3] It will be seen that at 460° C. all alloys containing more than a very small percentage of manganese lie in the (α + $MnAl_6$) field.

The structures of alloys whose compositions lie in the 1%-silicon section across the tetrahedral model have now to be considered, and the results obtained are summarized in Fig. 7, which is based on the study of 16 alloys annealed for 30 days at 460° C. The addition of

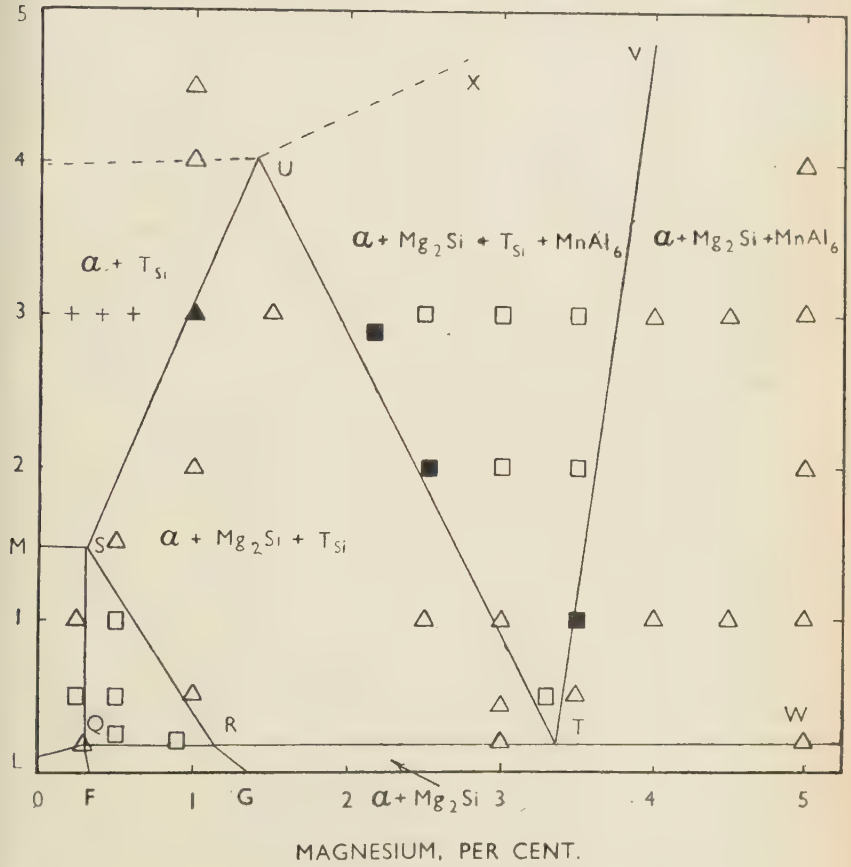

FIG. 10.—The Quinary System Al–Mg–Mn–Zn–Si. Equilibrium Diagram of alloys containing 4% zinc and 1% silicon at 460° C.

1% silicon to the aluminium-rich Al–Mn–Zn alloys results in the disappearance of the $MnAl_6$ phase, the manganese appearing in the form of the ternary (Al–Mn–Si) or T_{Si} phase. The points *M* and *L* in Fig. 7 are obtained from the intersections of the 1%-silicon line in Fig. 3 with the lines *HJ* and *HK* of the ternary Al–Mn–Si diagram. From Fig. 7 it will be seen that, with increasing zinc content, the boundary between

the ($\alpha + T_{Si} + Si$) and ($\alpha + T_{Si}$) fields moves to slightly higher percentages of manganese.

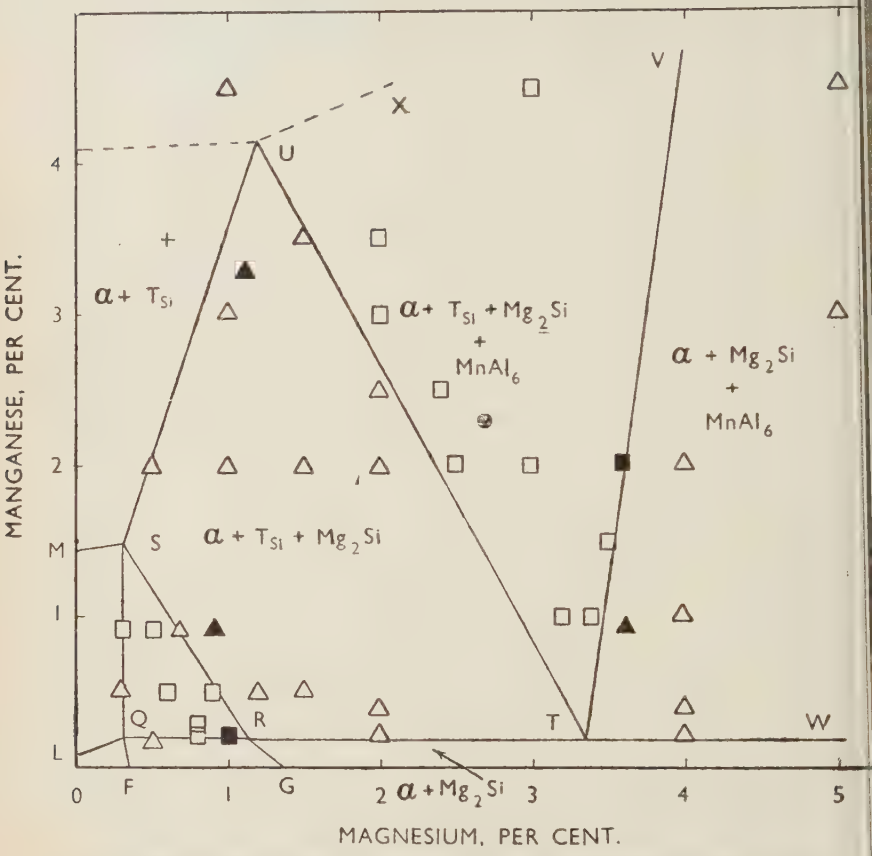

FIG. 11.—The Quinary System Al–Mg–Mn–Zn–Si. Equilibrium Diagram of alloys containing 8% zinc and 1% silicon at 460° C.

VI.—The Quaternary System Aluminium–Magnesium–Manganese–Silicon at 460° C.: Alloys Containing 1% Silicon.

The constitution of these alloys may again be represented by a right-angled tetrahedron with the system Al–Mg–Mn on the basal plane, and the systems Al–Mg–Si and Al–Mn–Si on the vertical faces. Fig. 8 shows the constitution of the Al–Mg–Mn alloys at 460° C., as estimated from previous work.[3] In the range of compositions with

which the present paper is concerned, all alloys with more than a very small percentage of manganese lie in the (α + $MnAl_6$) field.

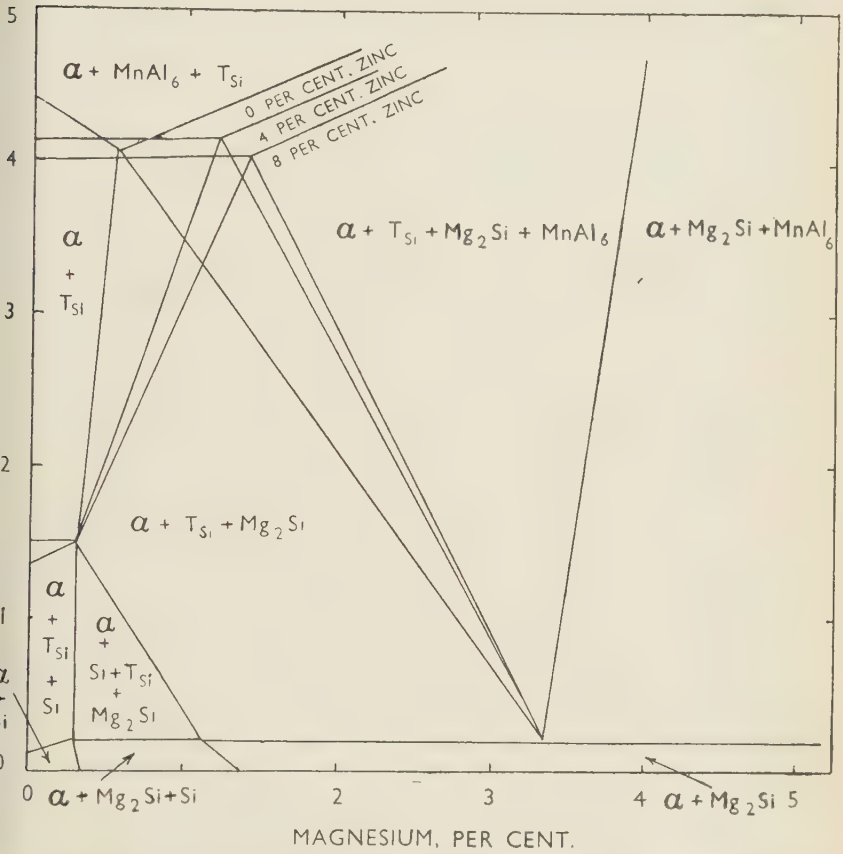

FIG. 12.—The Effect of Zinc on the Phase-Field Boundaries in Al–Mg–Mn–Zn–Si Alloys Containing 1% Silicon.

Fig. 9 shows the constitution of alloys containing 1% silicon, and is the horizontal section across the quaternary model lying above the basal plane of Fig. 8 at a distance equivalent to 1% silicon. This diagram is based on the study of 51 alloys, which were annealed for periods of 30 days at 460° C. The points *M* and *L* are inserted from the 1%-silicon line in the ternary system Al–Mn–Si (Fig. 3), and the points *F* and *G* from the corresponding line in the ternary system Al–Mg–Si (Fig. 1).

From Fig. 9 it will be seen that the effect of 1% silicon is to change the constitution of the alloys entirely, and that in the aluminium-rich alloys the $MnAl_6$ phase vanishes, and the manganese appears in the form of the ternary T_{Si} phase. In this respect, the effect is similar to that of 1% silicon in the Al–Mn–Zn–Si system (Figs. 6 and 7), and the T_{Si} phase appears to be more stable than the $MnAl_6$ phase. The existence of the very stable compound Mg_2Si makes the Al–Mg–Mn–Si diagram of Fig. 9 very much more complicated than the Al–Mn–Zn–Si diagram of Fig. 7. From Fig. 9 it will be seen that, with as little as 0·4% magnesium and 0·2% manganese, the 1%-silicon alloys of the system Al–Mg–Mn–Si lie in the 4-phase ($\alpha + Mg_2Si + T_{Si} + Si$) field. In the 3-dimensional model, this 4-phase field lies within a tetrahedron, the plane faces of which cut the section of Fig. 9 along the sides of the triangle *QRS*.

VII.—The Quinary System Aluminium–Magnesium–Manganese–Zinc–Silicon at 460° C.: Alloys Containing 1% Silicon and 4% and 8% Zinc.

In Fig. 9 has been shown the constitution at 460° C. of quaternary Al–Mg–Mn–Si alloys containing 1% silicon. In investigating the constitution of the quinary system Al–Mg–Mn–Zn–Si, it has been found most convenient to use Fig. 9 as the starting point, and then to construct similar diagrams for alloys containing 1% silicon and 4% zinc, and 1% silicon and 8% zinc, respectively. These diagrams are of the same general form, so that interpolation may be used to obtain the constitution at 460° C. of all quinary alloys containing 1% silicon, and 0–5% magnesium, and 0–4% manganese, and 0–8% zinc.

Fig. 10 shows the constitution of alloys containing 1% silicon and 4% zinc, and is based on the study of 40 alloys annealed for 30 days at 460° C. Fig. 11 is the corresponding diagram for alloys containing 8% zinc, and involves the study of 36 alloys, annealed for 30 days. Comparison of Figs. 9, 10, and 11 shows that the addition of zinc has little effect on the position of the point *S* where the ($\alpha + T_{Si}$), ($\alpha + T_{Si} + Mg_2Si$), ($\alpha + Mg_2Si + Si + T$), and ($\alpha + T_{Si} + Si$) fields meet, and has also little effect on the position of the point *T* where the ($\alpha + Mg_2Si$), ($\alpha + T_{Si} + Mg_2Si$), ($\alpha + T_{Si} + Mg_2Si + MnAl_6$), and ($\alpha + Mg_2Si + MnAl_6$) fields meet. The point *U* where the ($\alpha + T_{Si}$), ($\alpha + MnAl_6 + T_{Si}$), ($\alpha + T_{Si} + Mg_2Si + MnAl_6$), and ($\alpha + T_{Si} + Mg_2Si$) fields meet is, however, displaced in the direction of higher magnesium content as the zinc content increases. This effect is shown in Fig. 12, where the phase-field boundaries from Figs. 9, 10, and 11 are compared.

ACKNOWLEDGEMENTS.

The authors must express their thanks to Professor C. N. Hinshelwood, F.R.S., for laboratory accommodation and many other facilities which have greatly encouraged the present research.

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THE EFFECT OF 1% SILICON ON THE MELTING POINTS OF ALUMINIUM–MAGNESIUM–MANGANESE–ZINC ALLOYS.*

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Synopsis.

The melting points of Al–Mg–Mn–Zn–Si alloys containing 1% silicon have been determined for alloys containing from 0–8% magnesium, 0–2% manganese, and 0–8% zinc. The results are compared with those for the corresponding quaternary Al–Mg–Mn–Zn alloys. The data are presented graphically and enable the effect of 1% silicon on the melting point of any Al–Mg–Mn–Zn alloy in the above-mentioned range of composition to be deduced. The general conclusion is that if the magnesium content is less than 1 or 2%, the melting point of the alloy may be lowered markedly by the addition of 1% silicon; the effect is sometimes as great as 75° C. If the magnesium content exceeds about 4%, the melting point of the alloy is not lowered by the addition of 1% silicon, and a considerable increase in melting point may sometimes be obtained if the proportions of the constituents are adjusted suitably.

I.—Introduction.

In previous papers [1, 2, 3, 4, 5] the equilibrium diagram of the quaternary || system Al–Mg–Mn–Zn has been described, and later work [6] has established the constitution of some quinary Al–Mg–Mn–Zn–Si alloys at 460° C. It was reported to the authors that, when made from impure metals, some Al–Mg–Mn–Zn alloys showed unexpected "burning" after heat-treatment, as though melting had occurred at temperatures much lower than those indicated by the equilibrium diagrams for alloys made from pure materials. It was suggested that this phenomenon might be connected with unduly high percentages of silicon. The present paper describes an investigation of the effect of 1 wt.-% of silicon on the melting points of Al–Mg–Mn–Zn alloys, and is thus a determination of part of the solidus of the quinary system Al–Mg–Mn–Zn–Si. The work has established that the effect of 1% silicon varies

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|| For abbreviation chemical symbols have been used, because if the names are written in full the constituents of a complex system often run into two lines of print, and clarity is lost.

greatly with the composition of the alloy, and that according to the composition of the alloy concerned the melting point may be either raised or lowered by an amount which is sometimes as great as 40° C.

II.—Experimental Methods.

The alloys were prepared from super-purity aluminium supplied by the British Aluminium Company, Ltd. The remaining metals were of high purity, the details of which have been given in a previous paper,[6] which also describes the technique of melting and casting. Using these metals, the alloys were obtained in the form of chill-cast ingots $\frac{3}{8}$ in. in dia., which had been very rapidly chilled in heavy copper moulds; the resulting alloys possessed very fine microstructures.

The annealing of the alloys was carried out in electrical resistance furnaces controlled by Foster temperature regulators. Experiment showed that at the higher temperatures involved in the solidus determinations, alloys annealed in glass tubes were liable to pick up silicon from the glass, with a resulting variation in composition. For this reason all specimens were annealed in alumina collars enclosed in sealed evacuated glass tubes. In this way contact between the specimen and the glass tube was prevented, and no contamination occurred. Many of the cast ingots contained constituents melting at relatively low temperatures, and the general procedure adopted was, therefore, to begin the annealing at 300° C. and to raise the temperature at a rate of 50° C. per day until a point about 40° C. below the expected solidus was reached. The alloys were annealed at this temperature for several days without accurate control,* and were then quenched in iced water. Small specimens of the quenched ingots were re-annealed at higher temperatures for a period of 24 hr., during which the accuracy of the control was of the order $\pm 1°$ C. The specimens were then quenched, and examined microscopically, and the solidus point for each alloy was determined as lying between temperature brackets of 5° C. or less.

The methods of grinding and polishing were the same as those described in the previous papers. Large quantities of chilled liquid were seen clearly in the unetched polished sections, but etching was always necessary when the amount of chilled liquid was small. The most satisfactory reagent was found to be nitric acid vapour † which turned the chilled liquid dark brown and black. This etching treatment attacked crystals of Mg_2Si with the formation of a blue-black tarnish,

* The control was usually of the order $\pm$ 3° C.

† For this purpose, the specimen is placed in a glass spoon bent at right angles to its handle which is stuck into the cork of a wide-mouthed bottle containing a little concentrated nitric acid.

but left the remaining phases unaffected. The appearance of Mg_2Si is totally different from that of chilled liquid, and in this way the structure of the alloys was revealed with certainty.

The alloys were examined carefully to ensure that the results were not vitiated by segregation. No evidence was found for the existence of longitudinal segregation, but in some cases the extreme outside of the alloy possessed an abnormal structure which clearly resulted from a slight loss of magnesium by volatilization. For this reason, a layer of 1 mm. thickness was removed from all specimens before they were sent for analysis. The analyses were always carried out on the actual specimen used for microscopical examination. The necessity for keeping the analysis within reasonable limits prevented the separate analysis of the piece of an alloy quenched from just above the melting point, and of that quenched from just below the melting point. The lumps of alloy from either side of a temperature bracket were therefore dissolved together and the resulting solution analysed. As the temperature brackets were seldom greater than 5° C., the error produced by this procedure was negligible. The chemical analysis was undertaken by Messrs. Johnson, Matthey and Company, Ltd., and the authors must express their thanks to Mr. A. R. Powell for his constant care and attention.

III.—Experimental Results.

1. *The* (x–0–0)1 *or Aluminium–Magnesium–Silicon Series.*

For abbreviation, the authors refer to an alloy containing x% magnesium, y% manganese, z% zinc, and s% silicon as an (x, y, z)s alloy. The aluminium–magnesium–silicon alloys containing 1% silicon are thus the (x–0–0)1 series, and Fig. 1 shows the solidus points for these alloys. Alloys containing less than 1·15% magnesium consist * immediately below their melting points of homogeneous α solid solution, and melt to form (α + liquid), the melting points being given by the line *AB*. With higher percentages of magnesium, the alloys, immediately below their melting points, consist of (α + Mg_2Si), and melt to form (α + Mg_2Si + liquid), the melting points being given by the curve *BCD*. The line *XY* represents the melting points of binary aluminium–magnesium alloys, and is thus part of the solidus curve of the system aluminium–magnesium.

From this diagram, it will be seen that the effect of 1% silicon is to lower the melting point of alloys containing less than 3·6% magnesium.

* It will be appreciated that this statement refers to the constitution of alloys immediately below their melting points, and that at lower temperatures the alloys will not all lie in the homogeneous α region.

The effect is greatest for the alloy (1·15–0–0)1, whose melting point is more than 50° C. lower than that of the alloy (1·15–0–0)0. In contrast to this, alloys containing 1% silicon and more than 3·6% magnesium (i.e. alloys lying to the right of the point *C* in Fig. 1) have melting points

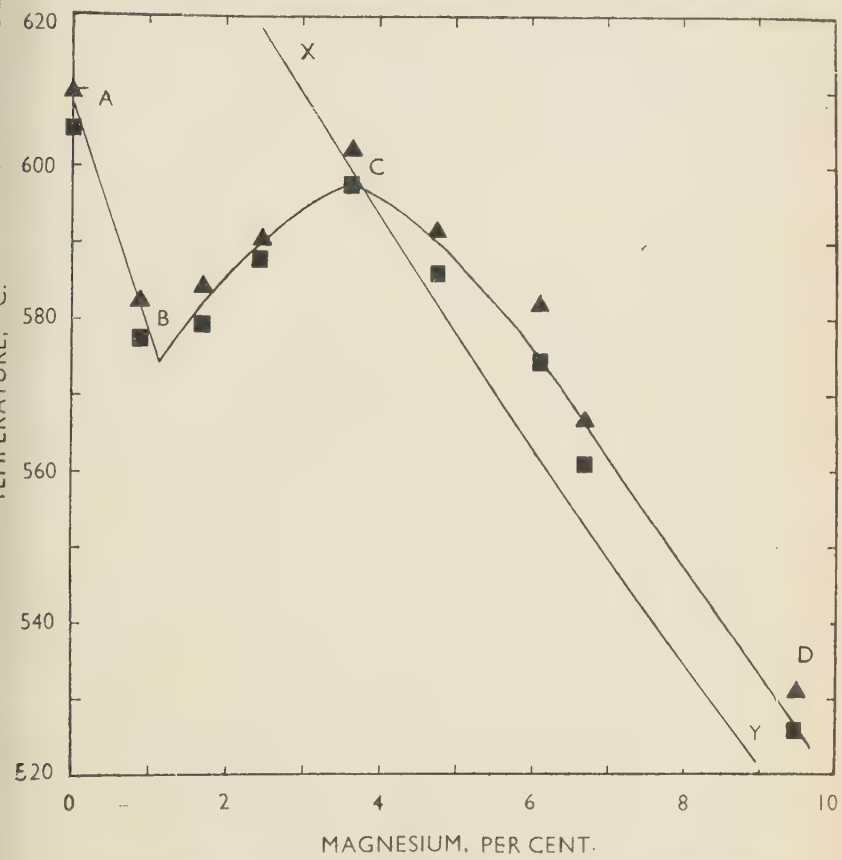

Fig. 1.—The Melting Points of Al–Mg–S Alloys Containing 1% Silicon ((*x*–0–0)1 Series). The line *X Y* shows the melting points of the corresponding Al–Mg Alloys.

which are slightly higher than those of binary alloys of aluminium and magnesium of the same magnesium content.

2. *The* (*x*–0–4)1 *Alloys.*

Fig. 2 shows the results obtained for alloys containing 4% zinc, 1% silicon, and varying percentages of magnesium. This Figure is of

the same general form as Fig. 1, but the effects are much more pronounced. Alloys with less than 0·94% magnesium consist, immediately below their melting points, of homogeneous α solid solution, and will melt to form (α + liquid), the solidus temperatures being given by the curve *AB*. With higher percentages of magnesium, the alloys immediately below their melting points consist of (α + Mg_2Si), and melt to

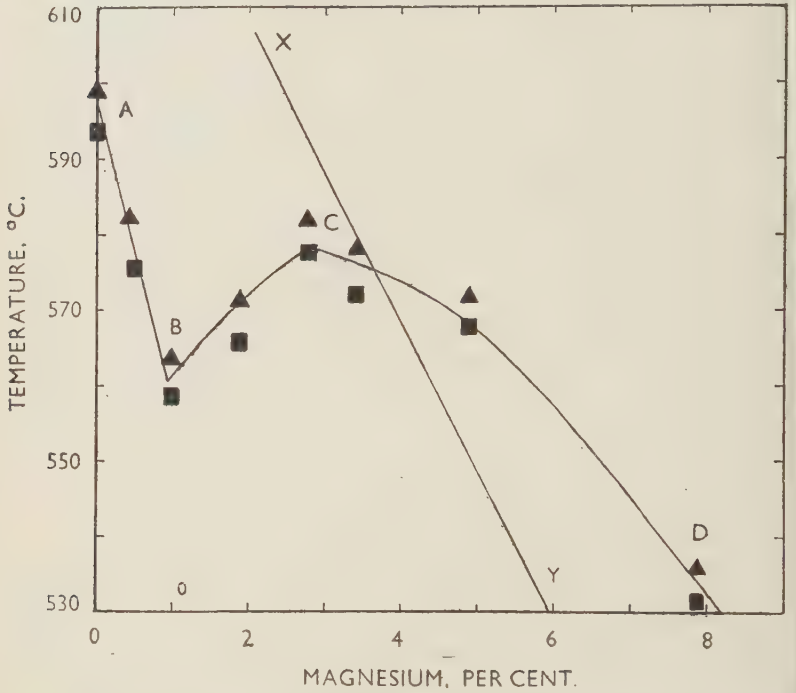

Fig. 2.—The Melting Points of Al–Mg–Zn–Si Alloys Containing 4% Zinc and 1% Silicon ((*x*–0–4)1 Series). The line *XY* shows the melting points of the Al–Mg–Zn (4% Zn) alloys without silicon.

form (α + Mg_2Si + liquid); the melting points of these alloys are given by the curve *BCD*, which rises to a maximum, as is the case for the corresponding curve in Fig. 1.

The line *XY* represents the melting points of alloys of the (*x*–0–4)0 type, all of which consist of a ternary α solid solution immediately below their melting points. The alloy (0·94–0–4)1 has a melting point more than 60° C. lower than that of the corresponding (0·94–0–4)0 alloy, but as can be seen from Fig. 2, the line *XY* cuts the curve *BCD* at 3·65% magnesium, and beyond this point the alloys containing 1%

silicon have higher melting points. The effect is quite considerable, and the melting point of the alloy (6–0–4)1 is about 27° C. higher than that of the alloy (6–0–4)0.

3. *The* (*x*–0–8)1 *Series.*

The results for the (*x*–0–8)1 series of alloys are shown in Fig. 3, the interpretation of which is similar to that of Figs. 1 and 2.

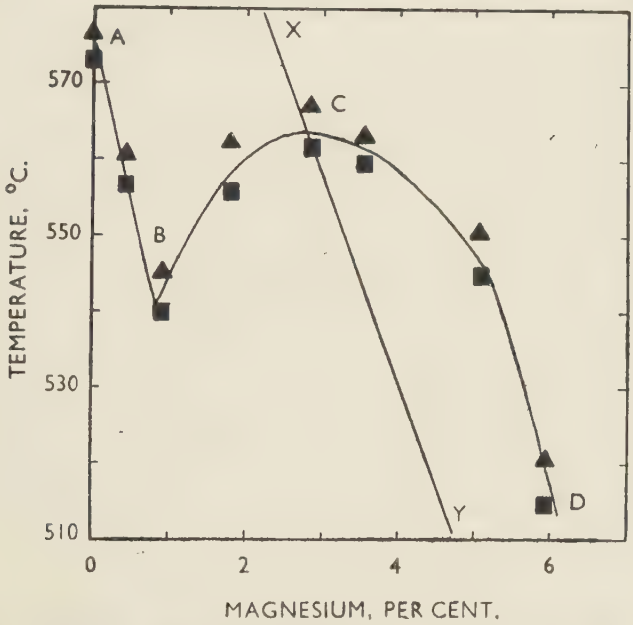

FIG. 3.—The Melting Points of Al–Mg–Zn–Si Alloys Containing 8% Zinc and 1% Silicon ((*x*–0–8)1 Series). The line *XY* shows the melting points of the Al–Mg–Zn (8% Zn) alloys without silicon.

The tendency noted on passing from Fig. 1 to Fig. 2 is maintained on passing to Fig. 3, from which it will be seen that the alloy (0·8–0–8)1, i.e. point *B*, melts at a temperature 75° C. lower than that for alloy (0·8–0–8)0. On the other side of the maximum in the curve *BCD*, the alloy (4·8–0–8)1 melts at a temperature about 38° C. higher than the alloy (4·8–0–8)0.

4. *The* (*x*–1–0)1 *Series.*

Provided that the magnesium content is less than about 5%, the addition of 1% manganese to the (*x*–0–0)1 series of alloys results in the formation of the ternary aluminium–manganese–silicon phase which

has been previously called T_{Si}. The solidus points for this series of alloys are shown in Fig. 4. Alloys containing less than about 1·6% magnesium consist, immediately below their melting points, of ($\alpha + T_{Si}$), and melt to form ($\alpha + T_{Si}$ + liquid), the solidus points of these alloys being given by the curve *AB* in Fig. 4. On increasing the magnesium content beyond 1·6%, the compound Mg_2Si is present in the solid alloy

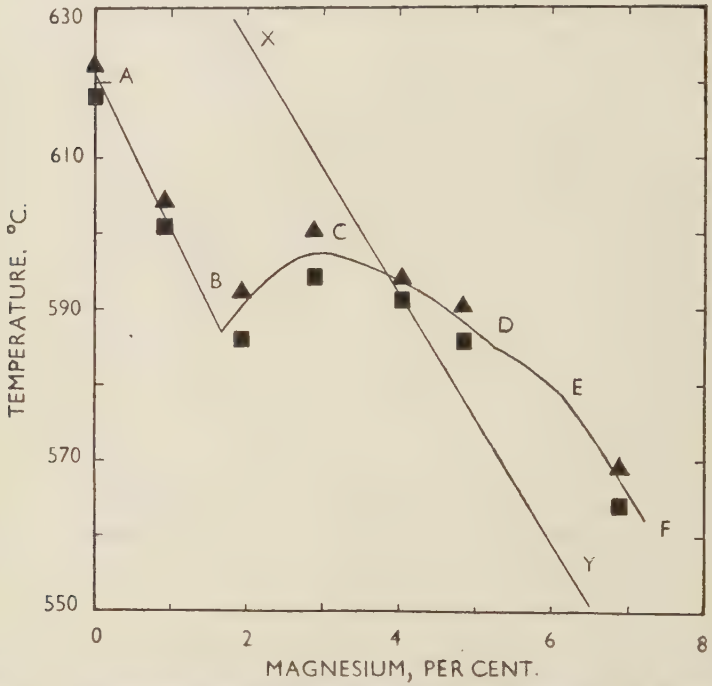

FIG. 4.—The Melting Points of Al–Mg–Mn–Si Alloys Containing 1% Manganese and 1% Silicon ((*x*–1–0)1 Series). The line *XY* shows the melting points of the Al–Mg–Mn (1% Mn) alloys without silicon.

at its melting point, and the alloy just above the solidus consists of ($\alpha + T_{Si} + Mg_2Si$ + liquid); the melting points of these alloys are given by the curve *BCD* in Fig. 4. With still higher percentages of magnesium, the T_{Si} phase disappears, and the alloys at their melting points consist of ($\alpha + MnAl_6 + Mg_2Si$), and melt to form ($\alpha + MnAl_6 + Mg_2Si$ + liquid). This change from one type of alloy to another occurs somewhere between *D* and *E* in Fig. 4, and does not produce any marked effect upon the melting points. For this reason

the exact temperature at which alloys of the (α + $MnAl_6$ + T_{Si} + Mg_2Si) type appear was not investigated.

In Fig. 4, the line XY represents the solidus points of ternary alloys of the (x–1–0)0 type. All these alloys immediately below their melting points consist of (α + $MnAl_6$), and melt to form (α + $MnAl_6$ + liquid).

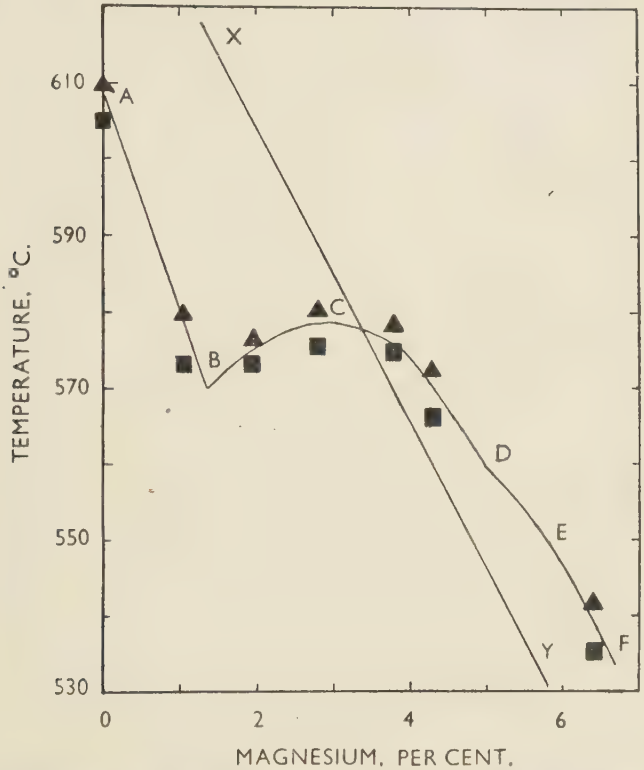

Fig. 5.—The Melting Points of Al–Mg–Mn–Zn–Si Alloys Containing 1% Manganese, 4% Zinc, and 1% Silicon ((x–1–4)1 Series). The line XY shows the melting points of the corresponding Al–Mg–Mn–Zn (1% Mn, 4% Zn) alloys without silicon.

From Fig. 4 it will be seen that in spite of the additional phases which result from the presence of manganese, the effect of 1% silicon on the melting points of (x–1–0)0 alloys is very similar to its effect on (x–0–0)0 alloys. With low magnesium contents, the melting point of the alloy is lowered by the addition of 1% silicon, the difference being as much as 40° C. for the alloy containing 1·7% magnesium (point B in Fig. 4). With higher magnesium contents, the melting point is raised by the

addition of 1% silicon, although the difference is not greater than 20° C. for the range of composition studied.

5. *The* (*x*–1–4)1 *and* (*x*–1–8)1 *Series.*

The solidus points for these alloys are shown in Figs. 5 and 6, in which the lines *XY* give the solidus points of the corresponding

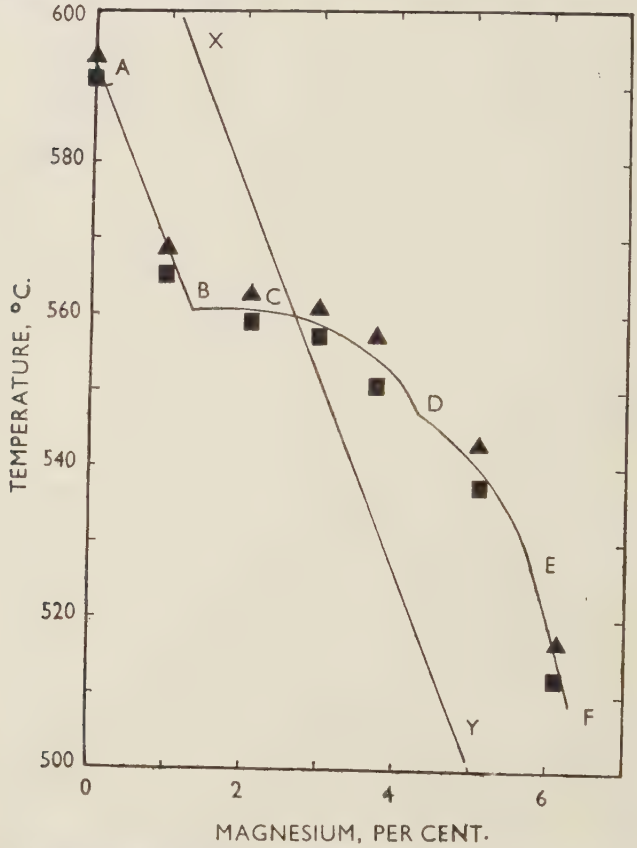

Fig. 6.—The Melting Points of Al–Mg–Mn–Zn–Si Alloys Containing 1% Manganese, 8% Zinc, and 1% Silicon ((*x*–1–8)1 Series). The line *XY* shows the melting points of the corresponding Al–Mg–Mn–Zn (1% Mn, 8% Zn) alloys without silicon.

(*x*–1–4)0 and (*x*–1–8)0 alloys. The interpretation of these Figures is the same as for Fig. 4, and the general characteristics are the same. The effect of increasing zinc content is clearly no longer progressive,

since the rise of melting point which can be obtained by the addition of 1% silicon is less in the (*x*–1–4)1 series than in the (*x*–1–0)1 or (*x*–1–8)1 series.

6. *The* (*x*–2–0)1, (*x*–2–4)1, *and* (*x*–2–8)1 *Series.*

The solidus points for these three series of alloys are shown in Figs. 7, 8, and 9. In these Figures, the alloys in ranges marked *AB* consist,

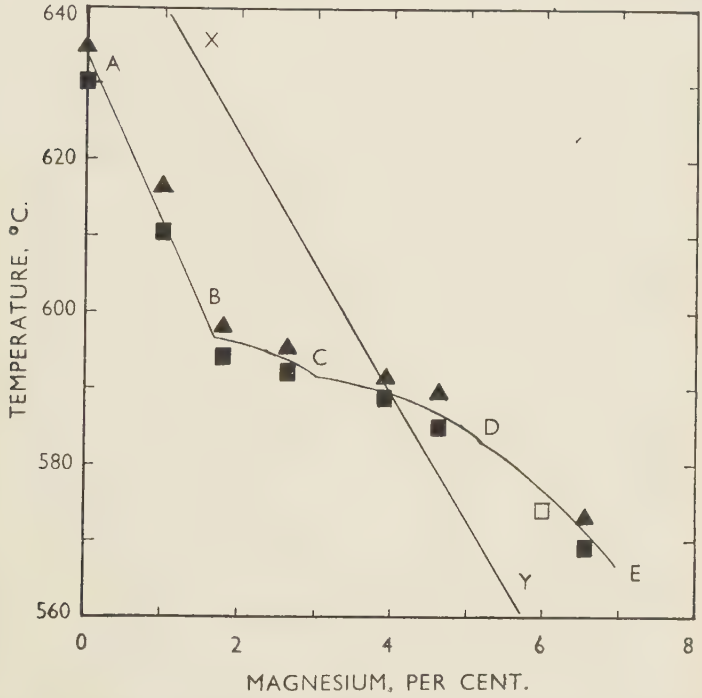

FIG. 7.—The Melting Points of the Al–Mg–Mn–Si Alloys Containing 2% Manganese and 1% Silicon ((*x*–2–0)1 Series). The line *XY* shows the melting points of the corresponding Al–Mg–Mn (2% Mn) alloys without silicon.

immediately below their melting points, of ($\alpha + T_{Si}$), and melt to form ($\alpha + T_{Si}$ + liquid). In these ranges, the effect of 1% silicon is to diminish the melting points of the corresponding alloys with zero silicon content; the effect is, however, not so great as in the alloys previously considered. From Figs. 7, 8, and 9, it will be seen that when the magnesium contents exceed those of the points *B*, the solidus curves show abrupt changes in direction, but do not rise to maxima as was the case in the earlier Figures. Over the portions of the curves marked

BC, the alloys immediately below their melting points consist of ($\alpha + T_{Si} + Mg_2Si$), and melt to form ($\alpha + T_{Si} + Mg_2Si$ + liquid). From *C* to *D*, the alloys immediately below their melting points consist

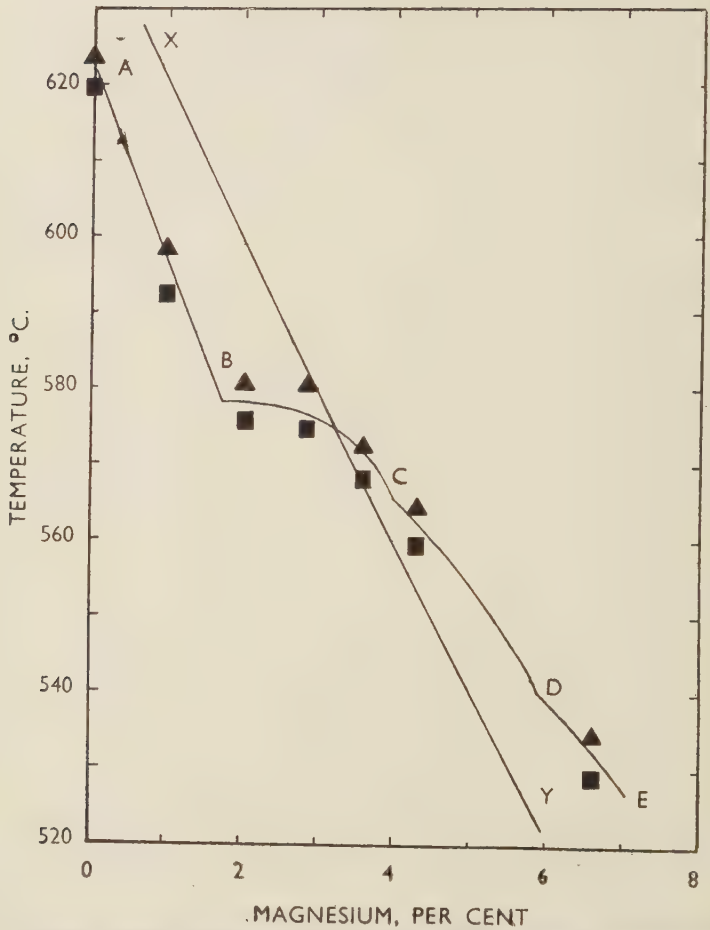

FIG. 8.—The Melting Points of the Al–Mg–Mn–Zn–Si Alloys Containing 2% Manganese, 4% Zinc, and 1% Silicon ((*x*–2–4)1 Series). The line *XY* shows the melting points of the corresponding Al–Mg–Mn–Zn (2% Mn, 4% Zn) alloys without silicon.

of ($\alpha + T_{Si} + Mg_2Si + MnAl_6$), and, as melting begins, all these four phases exist in equilibrium with liquid. Finally, in the portions of the curves marked *DE*, the T_{Si} phase has disappeared, and the alloys below

their melting points consist of (α + $MnAl_6$ + Mg_2Si), and melt to form (α + $MnAl_6$ + Mg_2Si + liquid).

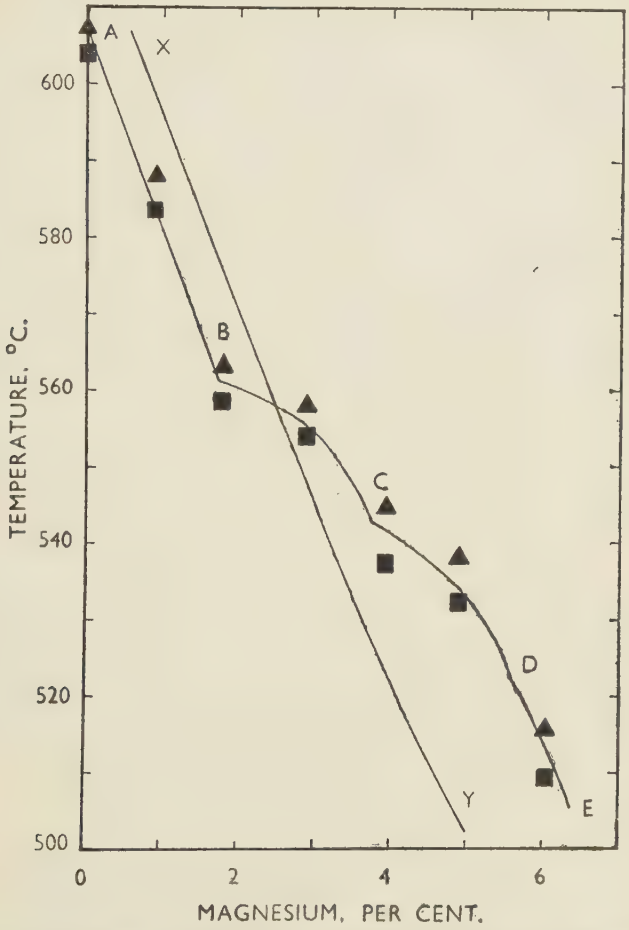

FIG. 9.—The Melting Points of the Al–Mg–Mn–Zn–Si Alloys Containing 2% Manganese, 8% Zinc, and 1% Silicon ((*x*–2–8)1 Series). The line *XY* shows the melting points of the corresponding Al–Mg–Mn–Zn (2% Mn, 8% Zn) alloys without silicon.

From Figs. 7–9 it will be seen that, although the portions of the curves marked *BCD* do not rise to maxima, the change in direction is eventually sufficient to raise the melting points of the alloys containing 1% silicon above those of alloys of zero silicon content.

IV.—Discussion.

The previous diagrams show clearly the way in which the melting points of Al–Mg–Mn–Zn alloys are affected by the addition of 1% silicon, and interpolation may be used to obtain the melting point of any alloy in the range 0–5% magnesium, and 0–8% zinc. The general conclusion can be drawn that the melting point will not be lowered if the magnesium content exceeds 4%, and that a considerable increase in melting point may sometimes be obtained if the proportions of the constituents are adjusted suitably. On the other hand, a marked lowering of the melting point may occur if the magnesium content is of the order of 1–2%.

The general form of the diagram of Fig. 1 agrees with the equilibrium diagrams of the system Al–Mg–Si obtained by Hanson and Gayler,[7] whose paper contains a diagram * for the constitution of Al–Mg–Si alloys containing 1% silicon. This may be compared with Fig. 1 of the present paper, and the results are as shown below :

Present Paper.		Hanson and Gayler.	Present Authors.
Fig. 1.			
Point *A*		582° C.	609° C.
Point *B*		570° C.	575° C.
Point *C*		597° C.	597° C.

The two investigations are in good agreement except for point *A* [alloy (0–0–0)1], where the higher value obtained in the present work is presumably due to the greater purity of the silicon. The general form of the solidus diagram of Fig. 1, with a maximum at *C*, was confirmed by Hanson and Gayler, who show that at *C* the solidus surface touches the surface of secondary separation, so that alloys of composition *C* have a strictly eutectic ($Al + Mg_2Si$) structure. The point *C* of the present Fig. 1 lies on the ridge *NO* of Hanson and Gayler's Fig. 32 (p. 336).

In Fig. 1 of the present paper, the point *B* at 574° C. represents the composition of the α solid solution in equilibrium with solid Mg_2Si and liquid. It is therefore a point on the α solid-solubility curve representing equilibrium between α and Mg_2Si. In the work of F. Keller and C. Craighead,[9] the $\alpha/(\alpha + Mg_2Si)$ solubility isothermals were studied in great detail over the range 200°–535° C. for alloys containing not more than 0·5% silicon. Their solubility isothermals were analysed by Hume-Rothery,[8] who showed that they obeyed an equation of the form :

$$[Mg]^2[Si] = K$$

* *J. Inst. Metals*, 1921, **26**, 326 (Fig. 5).

where [Mg] and [Si] are the atomic percentages of magnesium and silicon, respectively. If this represents an equilibrium of the mass-action type, a straight line should be obtained by plotting log K against the reciprocal of the absolute temperature, and as will be seen from Fig. 10, this is confirmed.

It should be explained that there is a slight uncertainty about the exact positions of these points because the solubility isothermals of Dix, Keller, and Graham do not agree absolutely with the equation

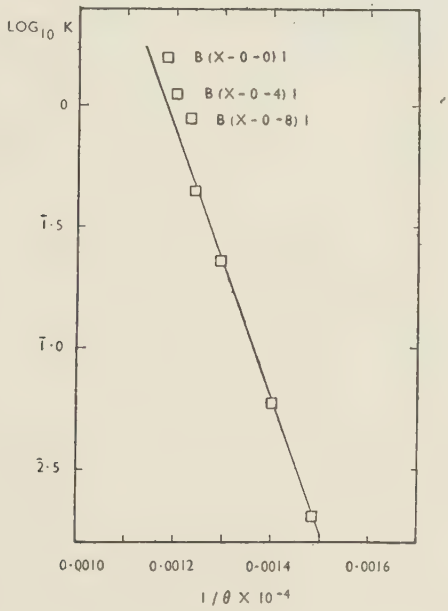

Fig. 10.

above, and it is necessary to use what appears to be the most probable value of K. In Fig. 10, the point marked $B(x\text{–}0\text{–}0)1$ is obtained by plotting log $[Mg]^2[Si]$ against $1/\theta$, using the values for point B in Fig 1. This point refers to a temperature 40° C. above the highest studied by Dix *et alia*, and lies on the opposite side of the solubility region investigated by these workers, since they did not use alloys containing more than 0·5% silicon. In spite of the extrapolation of both temperature and composition, it will be seen that a fair agreement is obtained with the earlier data, and this may be regarded as a confirmation of the hypothesis that the $\alpha/(\alpha + Mg_2Si)$ isothermals are controlled by the mass action principle.

In considering the effect of zinc on this type of equilibrium, it was thought that the wide solubility of zinc in aluminium might be taken to indicate that atoms of zinc and aluminium could, to a first approximation, be regarded as identical. In this case, an alloy containing *in atomic percentages* x% magnesium, y% zinc, 1% silicon, and $(99 - x - y)$% aluminium may be regarded as equivalent to a ternary Al–Mg–Si alloy containing x% magnesium, 1% silicon, and $(99 - x)$ at.-% aluminium. On this simplifying assumption, what may be called the adjusted values of [Mg] and [Si] were read off from Figs. 2 and 3, and the resulting values of K were used to plot the points marked $B(x\text{–}0\text{–}4)1$ and $B(x\text{–}0\text{–}8)1$ in Fig. 10. These points are again in reasonable agreement with the log $K/1/\theta$ line for the low-temperature isothermals. Further, the fact that in Fig. 10 the gradient of the line through the $B(x\text{–}0\text{–}0)1$, $B(x\text{–}0\text{–}4)1$, and $B(x\text{–}0\text{–}8)1$ points is the same as that through the lower points may be taken to indicate that the heat of formation of Mg_2Si from magnesium and silicon in solid solution in aluminium is not materially affected by the presence of 8 wt.-% of zinc.

The addition of manganese to the Al–Mg–Mn–Si alloys results in the production of the relatively stable compounds $MnAl_6$ and T_{Si}, and the above simple theory is no longer applicable.

ACKNOWLEDGEMENTS.

The authors must express their thanks to Professor C. N. Hinshelwood, F.R.S., for laboratory accommodation and many other facilities which have greatly encouraged the present research.

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REPORT OF COUNCIL

for the Year Ended 31 *December* 1947.

The Council submits this Report to the members with a feeling of satisfaction that much has been done, in the year under review, to consolidate and improve the Institute's position and to return to pre-war standards.

As a result of depletion of staff and the general difficulties arising from the war, it was inevitable that administrative problems should have accumulated which required urgent attention. Not the least important of the achievements of the year has been the steady overhaul of the Institute's administration and records and the reorganization of its staff and their duties, in preparation for expansion and developments not only in services, but in membership. This work, though not spectacular, has made heavy demands on the staff during a year which has been an unusually active one in other directions.

The high standard that the Institute has set in its *Journal* has been well maintained, and many more papers have been published than ever before. The Council regrets, however, the infrequency of the publication of papers dealing with the industrial processes and plant. It was with much pleasure, therefore, that the Council received and accepted an offer by Messrs. Capper Pass and Son, Ltd., to provide a sum of £200 annually, for a period of seven years, to be available to the Institution of Mining and Metallurgy and the Institute of Metals for Awards for the encouragement of papers on extraction metallurgy and the processes and plant in the non-ferrous metal industries. It is hoped that this generous action will stimulate the writing and publication of papers on industrial problems related to the fabrication of non-ferrous metals and their alloys.

The Institute's membership, the revenues from advertisements, and the sales of publications have shown considerable increases. It is becoming generally recognized that the *Journal* and *Metallurgical Abstracts* are essential to every metallurgist engaged in the field of non-ferrous metallurgy. The Council must emphasize, however, that the problem of finance still limits the Institute's services and the development of its publications. While the present membership is not unsatisfactory, it is capable of extensive development in the British Isles and overseas, as it is still by no means fully representative of the field which the Institute serves. It is hoped that members will make considerable efforts during the forthcoming year to increase it. A large increase in membership would enable the Institute to develop its services and, in particular, to improve and extend its publications. A List of Members, which will be issued in the first half of 1948, will be of great assistance in membership development.

The Council is reconsidering ways in which the Institute's services may be extended and developed, especially for members engaged in industry and engineers and other users of non-ferrous metals. The circulation to members of a questionnaire to obtain their views regarding present and future services is under consideration. The views of members who, for one reason or another, are unable to attend the General Meetings of the Institute or the meetings of the Local Sections are particularly desired.

Secretaryship.

In view of the greatly increased activities of the Iron and Steel Institute and of the Institute of Metals, it was decided by the two Councils that the

administration of the work of the two Institutes under a Joint Secretary was no longer practicable and that each Institute should have a separate Secretary. In consequence, the post of Secretary to the Institute of Metals was advertised and the Council, on the recommendation of the Selection Committee, unanimously appointed Lieut.-Colonel S. C. Guillan, T.D., as Secretary of the Institute and Editor of its publications; he assumed his duties on 1 July 1947. In order that the Secretary may be free to devote a greater amount of his time to developing the Institute's services, it was also decided that consideration should be given to the separation of the appointments of Secretary and Editor.

The Council desires to record its appreciation of the services rendered to the Institute by Mr. K. Headlam-Morley as Joint Secretary from 1 July 1944 to 30 June 1947.

The close co-operation between the Iron and Steel Institute and the Institute of Metals which has been so successful during recent years will not be in any way affected by the change.

Membership.

The Institute's membership has steadily increased. The continued large additions to the Student Membership are particularly gratifying. During the year special arrangements have been made for the admission, at the Student Membership rate of subscription, of full-time University and Technical College or School students whose ages exceed the normal maximum for Student Members. This step has been taken as a temporary measure, to assist those whose studies have had to be deferred owing to war-time activities, and will be reviewed after 30 June 1949.

At 31 December	1940	1941	1942	1943	1944	1945	1946	1947
Honorary Members .	3	3	2	6	6	6	6	9
Fellows . . .	8	8	7	7	7	6	6	7
Ordinary Members .	1893	1862	1866	2018	2153	2213	2414	2491
Associate Members .	18	12	11	15	15	12	25	17
Student Members .	183	180	188	267	305	361	329	655
Active List . .	**2105**	**2065**	**2074**	**2313**	**2486**	**2598**	**2980**	**3179**
Suspense List . .	132	146	191	195	200	179	58	36
Total . .	2237	2211	2265	2508	2686	2777	3038	3215

(*Note :* The Suspense List does not include ex-enemy former members.)

Obituary.

It is with much regret that the Council records the deaths of Dr. J. W. Donaldson and Mr. H. H. A. Greer, J.P. (Fellow), both of whom had served on the Council.

The Council also records, with much regret, the deaths during 1947 of: Mr. E. A. Arliss; Mr. N. A. Clark, B.Sc. (Eng.); Mr. J. C. Clifton; Mr. R. E. Griffin; Mr. A. F. Haas; Mr. T. A. E. Holdengarde, O.B.E.; Mr. A. A. Jude; Mr. L. W. Kempf, M.S.; Mr. S. Moore; Mr. J. E. Openshaw, M.B.E., B.Eng., B.Sc.; Mr. G. C. Pitcairn; Mr. J. S. Glen Primrose, A.R.T.C.; Mr. H. Le R. Randall, Ph.B.; Mr. Robert Rigby; and Mr. P. W. Rolleston, B.A.

Officers of the Institute.

The undermentioned members were declared to be elected to fill vacancies as honorary officers of the Institute with effect from the 1947 Annual General Meeting:

President:

Colonel P. G. J. Gueterbock, C.B., D.S.O., M.C., T.D., D.L., J.P., M.A., A.D.C.

Vice-President:

John Cartland, M.C., M.Sc.

Members of Council:

Professor Leslie Aitchison, D.Met., M.Sc.
John Arnott.
Maurice Cook, D.Sc., Ph.D.
A. J. Murphy, M.Sc.

During the year Professor J. H. Andrew, D.Sc., resigned his seat on the Council, for personal reasons, and his resignation was accepted with regret; Mr. D. P. C. Neave, M.A., was elected to fill the vacancy.

Mr. H. S. Tasker, B.A., who had been Honorary Treasurer of the Institute since 1945, found it necessary to resign that office, owing to increased pressure of business. The Council accepted his resignation with very much regret and expressed its sincere thanks to him for the most valuable services that he has rendered to the Institute while Honorary Treasurer. Mr. W. A. C. Newman, B.Sc., A.R.S.M., A.R.C.S., has accepted the unanimous invitation of the Council to fill the vacancy. Mr. Tasker remains a Member of Council.

The Council is of the opinion that it is desirable to obtain a better balance on the Council as between the manufacturers of non-ferrous metals, the users, and those engaged in research and teaching. In the course of years this balance has been lost to some extent and should be rectified.

Honorary Members of Council.

Captain (E) J. G. C. Given, C.B.E., R.N., representing the Lords Commissioners of the Admiralty, and Major-General Sir Eustace Tickell, K.B.E., C.B., M.C., representing the Army Council, have been elected Honorary Members of the Council. Representatives are also appointed to the Council of the Institute of Metals by the Institution of Metallurgists and the Iron and Steel Institute.

Corresponding Members to the Council.

The Council desires to record its appreciation of the help and advice of the following members who have served as Honorary Corresponding Members to the Council during the year: Mr. H. N. Bassett (*Argentina*); Professor J. N. Greenwood, D.Sc. (*Australia*); Dr. O. W. Ellis (*Canada*); Professor P. A. J. Chevenard (*France*); Professor N. P. Gandhi (*India*); Dr. G. H. Stanley, A.R.S.M. (*South Africa*); Professor Dr. C. A. F. Benedicks (*Sweden*); Professor Dr. A. von Zeerleder (*Switzerland*); Professor Dr. N. W. Ageew (*Union of Soviet Socialist Republics*); and Dr. C. C. Smith (*United States of America*).

Election of Honorary Members.

During the year the Council elected Professor Pierre Antoine Jean Chevenard, Professor Sir Geoffrey Ingram Taylor, M.A., D.Sc., D.C.L., F.R.S.,

and Dr. John Fairfield Thompson, to be Honorary Members of the Institute, in recognition of their distinguished services to science and to the non-ferrous metal industries.

Election of Fellows.

Dr. Cecil Henry Desch, F.R.S., Mr. Henry Holme Airey Greer, J.P. (since deceased), and Lieutenant-Colonel Sir John Henry Maitland Greenly, K.C.M.G., C.B.E., M.A., were elected Fellows in recognition of their eminent services to the Institute.

Institute of Metals (Platinum) Medal.

The Institute of Metals (Platinum) Medal for 1947 was awarded jointly to Dr. Marie L. V. Gayler (Mrs. Haughton) and Dr. J. L. Haughton, in recognition of their outstanding services to the science of non-ferrous metallurgy.

Publications.

The *Journal* and *Metallurgical Abstracts* have continued to appear monthly, and the number of copies printed has been increased to meet the growth of membership and of sales; an advance-copy volume of a " Symposium on Internal Stresses in Metals and Alloys " was also issued during the year.

During the year 1947, 72 papers and addresses were published, including those contributed to the symposium. To deal with this record number of papers, the War-Time Emergency Fund, which was raised for this purpose, was drawn upon by the Publication Committee.

The News Section of the monthly *Journal* has been increased considerably, and members have expressed their appreciation of this development.

The work of abstracting got into arrears during the war years, but the greater part will have been overtaken by the publication, in the near future, of a special issue of *Metallurgical Abstracts*.

A Monograph (No. 4) by Dr. G. V. Raynor on " An Introduction to the Electron Theory of Metals " was published in May 1947. A reprint of Monograph No. 3 by Dr. W. Hume-Rothery, F.R.S., on " Atomic Theory for Students of Metallurgy " was issued in July 1947; the edition is already exhausted, and a further, revised, reprint is in the press. The fifth reprint of Monograph No. 1 on " The Structure of Metals and Alloys " by Dr. W. Hume-Rothery, F.R.S., has also been exhausted, and a further, revised, reprint is being made. The Council has commissioned monographs on " Non-Destructive Testing " and on " The Thermodynamics of Alloys ". Suggestions for further books for publication in this series will be considered by the Publication Committee.

There is a steady sale for the Annotated Equilibrium Diagrams. During the year a third reprint was published of No. 1 (system aluminium–zinc). An Annotated Equilibrium Diagram of the system beryllium–copper is in preparation.

Meetings of the Institute.

The Thirty-Ninth Annual General Meeting was held in London on 5, 6, and 7 March 1947. In connection with the meeting, a successful Dinner and Dance was held at the Savoy Hotel on 5 March. Visits to works and institutions in the London area were arranged on 6 March, and were much appreciated by members.

On 21 May 1947, Sir Wallace Akers, C.B.E., delivered in the Hall of the Institution of Civil Engineers, Great George Street, London, S.W.1, the Thirty-Seventh May Lecture on " Metallurgical Problems Involved in the Generation of Useful Power from Atomic Energy ".

A special General Meeting was held at the Institution of Civil Engineers on 22 May for the discussion of papers.

The Thirty-Ninth Annual Autumn Meeting was held in Glasgow from 23 to 26 September 1947, by invitation of the Scottish Local Section. It was one of the most successful held by the Institute. The Council desires to record its gratitude to the Committee of the Scottish Local Section for organizing such a memorable meeting, and also to Mr. Matthew Hay, the Honorary Secretary of the Reception Committee, on whom fell the greater part of the work carried out in connection with it. The Council has placed on record its appreciation of the work of its Staff in connection with the administrative arrangements made for this meeting.

On 15 and 16 October 1947 a symposium on " Internal Stresses in Metals and Alloys " was held at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. The meeting was planned by the Metal Physics Committee, in association with several allied scientific and technical societies.

This symposium, at which 36 papers were presented, was an undoubted success, and there was an attendance of more than 300 at each of the four sessions. The papers, together with a report of the valuable discussions that took place, will be published as No. 5 of the *Monograph and Report Series*.

The Council wishes to record its thanks to the associated societies for their help and advice in connection with the organization of this symposium.

Joint Meetings.

Joint meetings were held during the year with the Institute of Welding, in London, on 30 April 1947, when Dr. Maurice Cook read a paper on " The Welding of Copper and Copper-Rich Alloys ", and with the Manchester Metallurgical Society and the Iron and Steel Institute in Manchester on 26 November 1947, when Mr. E. W. Colbeck read a paper on " Some Metallurgical Problems in the Field of Atomic Energy ".

Local Sections.

The Local Sections have been active during the year and have had good programmes of papers and discussions. In addition, members have had the advantages of (free) membership of the Leeds Metallurgical Society and the Manchester Metallurgical Society, the Presidents and Honorary Secretaries of which attend meetings of the Local Sections Committee by invitation.

The Birmingham Local Section now includes Coventry and Wolverhampton in its area, and will arrange meetings in those towns in the session 1948–49. The name of the Swansea Local Section has been changed to South Wales Local Section, which more clearly indicates the area for which the Section is responsible.

The Local Sections Committee desires that papers read before the Sections shall be submitted to the Institute for publication in the *Journal*, when they are of sufficient merit.

Informal discussions between the Chairmen and Honorary Secretaries of the Local Sections have proved most valuable.

The President, with the Secretary or Assistant Editor, paid official visits to each of the Local Sections during the year. These visits were much appreciated and provided valuable opportunities for personal contact with local members.

Metal Physics.

The Metal Physics Committee and its sub-committees met frequently during the year and arranged, in association with other societies, a very

successful symposium on " Internal Stresses in Metals and Alloys ", to which reference is made elsewhere in this report.

It is proposed to arrange a symposium on " Metallurgical Applications of the Electron Microscope " in the autumn or winter of 1949.

The Committee is keeping closely in touch with the work on metal physics which is being undertaken by the British Iron and Steel Research Association and by the Ministry of Supply.

Nomenclature and Terminology.

The Nomenclature and Terminology Committee has met during the year and has published in the *Journal*, to obtain members' views, tentative proposals on the nomenclature of age-hardening and thermal processes. It also published its comments on certain terms which it regarded as objectionable.

It appeared to the Committee that, if wide acceptance was to be obtained for recommendations regarding metallurgical nomenclature and terminology, it was desirable to form, under the auspices of the British Standards Institution, a Joint Panel on which the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of British Foundrymen, and the Institute of Metals could be represented. The Council approved this recommendation, and, after obtaining the agreement of the allied societies mentioned above, has approached the British Standards Institution on this matter. It is hoped that the panel will be formed at an early date.

Liaison with Other Societies.

The President has served as an Honorary Member of Council on the Councils of the Iron and Steel Institute and the Institution of Metallurgists. The Joint Consultative Committee of the Iron and Steel Institute and the Institute of Metals has met several times to discuss problems of common interest.

To aid the Institution of Metallurgists, the Council has placed at its disposal certain rooms of its accommodation at 4 Grosvenor Gardens until 31 December 1948, free of rent and costs of services, and, to enable this arrangement to be made, the Iron and Steel Institute has allocated to the Institute of Metals, on the same terms, two of its attic rooms.

Staff.

The appointment of Lieut.-Colonel S. C. Guillan, T.D., as Secretary and Editor is referred to elsewhere. Major R. E. Moore was appointed Assistant Secretary during the year.

The Council expresses its appreciation of the loyalty and devotion to duty of the staff in a year during which heavy demands have had to be made on all its members.

JOINT ACTIVITIES.

Joint Library and Information Department.

The past year has been a record one for loans from the Joint Library, the total loans (parcels, not individual items) amounting to 8675 as compared with 7514 in 1946. Efforts have been made, with some success, during the year to obtain the war-time issues of foreign periodicals and books and to increase the number of periodicals regularly received. Most of the books on ferrous and non-ferrous metallurgy have been obtained—many of them in duplicate—and the collection of works on allied subjects has been extended.

Members are reminded that the use of the lending library represents a valuable privilege of membership. Books and periodicals are sent post-free to members, whose requirements may be met by the Joint Library from the great resources of the Science Library at South Kensington, with which the Iron and Steel Institute and Institute of Metals have special arrangements for borrowing. Those who desire to make use of the Library should apply to the Librarian, Mr. R. E. Elsdon, to receive free copies of all issues of the quarterly "Additions to the Library".

During the year the Information Department has been reorganized, under the direction of Dr. M. A. Vernon, and is expected to expand very largely in the future. It is prepared to answer scientific and technical enquiries and to prepare and supply bibliographies to meet members' special requirements. It is not its function to give the type of advice which is the field of the metallurgical consultant.

Members are invited to make greater use of the services of the lending library and of the Information Department. Authors of books and papers are requested to send copies to the library for record purposes; many valuable gifts have been received during the year.

Joint Committee for National Certificates in Metallurgy.

The scheme for the award of Ordinary and Higher National Certificates in Metallurgy has continued to make good progress. Schemes for the Senior and Advanced Courses submitted by various examining bodies have been agreed as suitable for submission to the Ministry of Education by Colleges and Schools under the arrangements and conditions governing the award of National Certificates in Metallurgy, and other schemes submitted by Technical Colleges for Senior and Advanced Courses leading to Ordinary and Higher Certificates have been approved and are in operation. Courses leading to a National Certificate in Metallurgy are now available at 18 Technical Colleges.

Final Examinations were held in 1947 at 11 of the Colleges; 69 students were successful in the examinations for the Ordinary Certificate, 13 gaining distinctions, and 18 passed for the Higher Certificate.

The Iron and Steel Institute, the Institution of Mining and Metallurgy, and the Institute of Metals have contributed to a Prize Fund, and prizes, in the form of books, were awarded to students of sufficient merit.

The three metallurgical Institutes which have operated the scheme for National Certificates in Metallurgy in co-operation with the Ministry of Education were joined in October 1947 by the Institution of Metallurgists.

Joint Committee on Metallurgical Education.

The Committee, which consisted of representatives of the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of British Foundrymen, and the Institution of Metallurgists, as well as of the Institute of Metals, has now been strengthened by co-opting representatives of education officers in industry, the City and Guilds of London Institute, the Association of Technical Institutes, and the Association of Principals of Technical Institutes. Professor Leslie Aitchison, D.Met., M.Sc., Professor of Industrial Metallurgy at Birmingham University, took over the Chairmanship from Dr. C. H. Desch, F.R.S., in June 1947.

Attention has recently been devoted by the Committee to the formulation of a long-term policy aimed at fulfilling its main objective of improving the standard and facilities for metallurgical education of all grades. In addition, it has continued its former work, including assisting parents and students seeking information regarding facilities for metallurgical education, and

compiling information on metallurgical films and arranging for their loan to colleges, schools, local societies, and works.

A second revised edition of the brochure " Metallurgy—A Scientific Career in Industry " is in the press.

Mond Nickel Fellowships Committee.

During the year 1947 a public announcement was made setting out the conditions, and inviting applications, for Mond Nickel Fellowships. Details of the conditions of awards were given in the May 1947 issue of the *Journal of the Institute of Metals*.

Approximately 40 applications were received and considered by the Committee, and awards for the year 1947 have been made to :

L. H. Walker.—To study the methods of application of group industrial research, particularly in relation to the fabrication of light metals. (Present employers : Reynolds Tube Co., Ltd., Llay Hall Works, Tyseley, Birmingham.)

D. R. G. Davies.—To study the application of statistical methods to plant metallurgical and management problems with particular reference to the steel industry. (Present employers : Richard Thomas and Baldwins, Ltd., Panteg Branch, Griffithstown, Pontypool, Mon.)

The Committee will shortly be inviting applications for 1948.

APPENDIX.

COMMITTEES.

The Committees of the Institute which have served during the year were constituted as follows at 31 December 1947 :

MAIN COMMITTEES.

Finance and General Purposes Committee.

Sir Arthur Smout (*Chairman*).

Ex-officio :

Col. P. G. J. Gueterbock (*President*).
Mr. W. A. C. Newman (*Honorary Treasurer*).
Dr. L. B. Pfeil (*Chairman, Publication Committee*).

Ordinary Members :

Major C. J. P. Ball.
Mr. W. F. Brazener.
Sir William Griffiths.
Mr. W. H. Henman.
Dr. J. W. Jenkin.
Mr. A. J. Murphy.
Mr. S. Robson.
Mr. H. S. Tasker.

Local Sections Committee.

Mr. W. F. Brazener (*Chairman*).

Ex-officio :

Col. P. G. J. Gueterbock (*President*).
Mr. W. A. C. Newman (*Honorary Treasurer*).

Representatives of Local Sections :

Mr. E. A. Bolton (*Birmingham, Chairman*).
Mr. E. H. Bucknall (*Birmingham, Hon. Secretary*).
Dr. J. H. Watson (*London, Chairman*).
Dr. E. C. Rhodes (*London, Hon. Secretary*).
Mr. A. B. Graham (*Scottish, Chairman*).
Mr. M. Hay (*Scottish, Hon. Secretary*).
Major F. Orme (*Sheffield, Chairman*).
Dr. W. R. Maddocks (*Sheffield, Hon. Secretary*).
Mr. H. Davies (*South Wales, Chairman*).
Mr. D. W. Hopkins (*South Wales, Hon. Secretary*).

Ordinary Members :

Dr. Maurice Cook.
Mr. R. Griffiths.
Mr. A. J. Murphy.
Professor H. O'Neill.
Professor F. C. Thompson.

Meetings Committee.

Dr. C. J. Smithells (*Chairman*).

Ex-officio :

Col. P. G. J. Gueterbock (*President*).
Mr. W. A. C. Newman (*Honorary Treasurer*).
Dr. L. B. Pfeil (*Chairman, Publication Committee*).

Ordinary Members :

Professor G. Wesley Austin.
Mr. W. F. Brazener (representing Local Sections Committee).
Mr. J. Cartland.
Dr. B. Chalmers.
Mr. R. Griffiths.
Mr. W. K. B. Marshall.
Mr. F. Mason.
Dr. J. H. Watson.

Membership Committee.

Mr. J. Cartland (*Chairman*).

Ex-officio :

Col. P. G. J. Gueterbock (*President*).
Mr. W. A. C. Newman (*Honorary Treasurer*).
Mr. E. A. Bolton (*Birmingham*).
Dr. J. H. Watson (*London*).
Mr. A. B. Graham (*Scotland*).
Major F. Orme (*Sheffield*).
Mr. H. Davies (*South Wales*).

Ordinary Members :

Professor L. Aitchison.
Dr. N. P. Allen.
Mr. W. F. Brazener.
Mr. R. Griffiths.
Dr. J. W. Jenkin.
Mr. W. K. B. Marshall.
Mr. S. Robson.

Publication Committee.

Dr. L. B. Pfeil (*Chairman*).

Ex-officio :

Col. P. G. J. Gueterbock (*President*).
Mr. W. A. C. Newman (*Honorary Treasurer*).
Sir Arthur Smout (*Chairman, Finance and General Purposes Committee*).

Ordinary Members :

Mr. John Arnott.
Professor G. Wesley Austin.
Dr. Maurice Cook.
Dr. C. H. Desch.
Dr. J. L. Haughton.
Mr. A. J. Murphy.
Professor H. O'Neill.
Dr. G. V. Raynor.
Mr. S. Robson.

SPECIAL COMMITTEES.

Medal Committee.

Col. P. G. J. Gueterbock (*President*) (*Chairman*).

Ex-officio :

President-Elect and

Not more than four medallists who are, or have been, Members of Council, to be selected by the President.

Metal Physics Committee.

Dr. N. P. Allen (*Chairman*).

Ex-officio :

Col. P. G. J. Gueterbock (*President*).
Dr. L. B. Pfeil (*Chairman, Publication Committee*).
Dr. C. J. Smithells (*Chairman, Meetings Committee*).

Ordinary Members :

Mr. G. L. Bailey.
Sir Lawrence Bragg.
Dr. B. Chalmers.
Dr. Maurice Cook.
Dr. J. L. Haughton.
Mr. H. W. G. Hignett.
Dr. W. Hume-Rothery.
Mr. A. J. Murphy.
Professor H. O'Neill.
Professor E. A. Owen.
Dr. G. V. Raynor.

Nomenclature and Terminology Committee.

Mr. R. Griffiths (*Chairman*).

Ex-officio :

Col. P. G. J. Gueterbock (*President*).

Ordinary Members :

Dr. N. P. Allen.
Dr. C. H. Desch.
Dr. J. L. Haughton.
Mr. A. J. Murphy.
Professor H. O'Neill.
Dr. L. B. Pfeil.

Nominations Committee.

Col. P. G. J. Gueterbock (*President*) (*Chairman*).
Sir William Griffiths.
Lt.-Col. Sir John Greenly.

REPORT OF THE HONORARY TREASURER
(MR. H. S. TASKER)

for the Financial Year ended 30 *June* 1947.

In my report last year it was estimated that, during the year under review, there would be a substantial deficit caused by the general increase of costs, by the return of much-needed staff from war service, and by the increased peace-time activities of the Institute. This anticipation was borne out by events, and, indeed, during the year costs of printing and other services mounted so rapidly that, by the time of the Annual General Meeting in March, there was a considerable increase in the anticipated deficit. It was clear that the breathing space which would be provided by drawing on the War-Time Emergency Fund would be much shorter than had been hoped, and Members were told then that the Council would find it necessary to rectify the situation quickly.

The year's deficit was met by the transfer from the War-Time Emergency Fund of £2623, and the Council decided that as from 1 July 1947, among other things, the membership subscription must be increased. This step will enable the Honorary Treasurer to present for the year 1947–48 a balanced budget, but of course, it does not affect figures for the year 1946–47.

To turn to the accounts themselves, it will be noticed from the Income and Expenditure Account that the membership figures still show a satisfactory increase, but that, on the other side of the account, practically every item of expenditure has increased. The main item, namely that of salaries, reflects not only the increase of staff, which has been referred to, but very necessary increases of remuneration to existing staff. The cost of our superannuation scheme is a new item to which Members have already signified their approval in principle.

I should like to draw attention also to the *Journal* Account which shows a turnover from £720 excess of income over expenditure in the previous year to a deficit of £340. Against an increase in receipts of nearly 25%, the cost of production has increased by over 50%, due to substantial increases in costs of paper, blocks and printers' wages.

One satisfactory feature is that the Special Publications Account has, during the year under review, practically paid its way.

Turning to the Balance Sheet, the form of presentation is the same as that of the previous year; two items only require special mention. It will be seen that there has been a considerable alteration in the investments held by the Institute. The Institute held a substantial amount of comparatively short-dated $3\frac{1}{2}\%$ War Loan, and was in danger of suffering a serious loss of income when this fell due for re-payment, owing to the drop in interest rates. Acting on the advice of the Institute's brokers, therefore, these were sold at a premium and replaced by $2\frac{1}{2}\%$ Consols. The latter were again sold and replaced at a later date by Railway Stock, bought at a substantial discount against the take-over price at which these will be converted into new Government Transport Stock on 1 January 1948. It is hoped by this means that, although the Transport Stock will not earn as high a rate of interest as the original War Loan, the effect will be mitigated by the fact that a greater quantity of the Stock will be held as the result of these transfers.

It will be noticed that at the end of the year the Institute had an overdraft at the bank. It usually happens that after 1 July membership subscriptions

come in very rapidly, and in view of this fact it was not thought wise to realize any investments in order to liquidate the overdraft at a time which would have been disadvantageous. Nevertheless, at some point during the current year, some liquidation will have to take place in order to replace the excess expenditure of 1946–47.

It may well be hoped, and indeed expected, that the alteration in subscription rates will remove the difficulties which have been threatening the Institute from the financial point of view during the year 1946–47.

THE INSTITU

BALANCE SHEET

30.6.46. £	£	£	LIABILITIES.	£ s. d.	£ s.
			CURRENT LIABILITIES.		
	761		Sundry Creditors for accrued expenses . . .	383 9 4	
	1,099		*Journal* Accounts	395 0 0	
	364		Subscriptions paid in advance	278 7 9	
	132		Lloyds Bank, Ltd.—Overdraft	2,128 15 1	
	505		Special Publications Accounts	—	
61					3,185 12
			CURRENT SURPLUSES.		
			Excess of Assets over Liabilities :	£ s. d.	
		7,261	Balance as at 30 June 1946 . .	7,393 7 9	
			Add Transfer from War-Time		
		—	Emergency Fund	3,050 0 0	
				10,443 7 9	
			Less Excess of Expenditure over		
		133	Income for Year to date . .	2,816 0 5	
	7,394				
				7,627 7 4	
			Amount due to War-Time Emer-		
		—	gency Fund	233 19 7	
					7,393 7 9
	750		*Special Publications Account*		750 0 0
	7,767		*War-Time Emergency Fund* . . .	4,909 15 2	
15,911					
		—	*Add* Amount due from General		
	—		Fund	233 19 7	
					5,143 14 9
					13,287 2
			RESERVES.		
	20,292		*Endowment Fund*		20,986 16 7
			Reserve Fund :		
	5,000		Balance as at 30 June 1947		5,000 0 0
			Entrance Fees :		
		3,473	Balance as at 30 June 1946 . .	3,772 3 11	
			Amounts Received for the Year to		
		299	date	283 10 0	
	3,772				
					4,055 13 11
29,064					30,042 10

REPORT TO THE MEMBERS OF THE INSTITUTE OF METALS.

We have audited the above Balance Sheet dated 30 June 1947, and report that we have obtained all t information and explanations we have required.

In our opinion, the above Balance Sheet is properly drawn up so as to exhibit a true and correct view the state of the Institute's affairs, according to the best of our information and the explanations given to and as shown by the Books of the Institute.

POPPLETON & APPLEBY,
CHARTERED ACCOUNTANTS,
BIRMINGHAM AND LONDON.

31 *October* 1947.

Approved on behalf of the Council

P. G. J. GUETERBOCK, *President.*
H. S. TASKER, *Hon. Treasurer.*
A. J. G. SMOUT, *Chairman, Finance and General Purposes Committee.*
S. C. GUILLAN, *Secretary.*

22 *January* 1948.

£47,836 £46,515 5

OF METALS.

AT 30 JUNE 1947.

30.6.46.

ASSETS.

£	£	£		£ s. d.	£ s. d.	£ s. d.
			FIXED ASSETS.			
	1		*Office Furniture :*			
			Balance at cost, *less* amount written off . . .		1 0 0	
	1		*Library Books, &c. :*			
			Balance at cost, *less* amount written off . . .		1 0 0	
2						2 0 0
	1		CURRENT ASSETS.			
			Stock of Journals and Special Publications :			
			At Nominal Valuation		1 0 0	
			Sundry Debtors :			
	491		Unpaid Subscriptions	697 14 1		
	46		,, Entrance Fees	65 2 0		
	892		*Journal* Accounts	1,138 5 2		
	130		Income Tax Recoverable . . .	144 0 9		
			Advance to Institution of Metal-			
	250		lurgists	250 0 0		
	1,809			2,295 2 0		
			Less Reserve for Doubtful Sub-			
	329		scriptions	334 9 0		
1,480					1,960 13 0	
			CASH.			
			General Fund :			
			Lloyds Bank, Ltd.,	£ s. d.		
	368		Deposit Account .	16 7 8		
			Post Office Savings			
	—		Bank	2 1 8		
	—		Cash in Hand. . .	11 18 10		
	1		Cash Overdrawn . .	—		
				30 8 2		
	367		*Special Publications Account :*			
	363		Post Office Savings Bank . . .	920 18 10		
			(£170 18*s.* 10*d.* of this Account belongs to General Fund.)			
			War-Time Emergency Fund :			
			Post Office Savings			
	3,242		Bank 357 3 9			
			Lloyds Bank, Ltd.,			
	98		Deposit Account . 121 14 1			
				478 17 10		
			Endowment Fund :			
			Lloyds Bank, Ltd., Deposit Ac-			
	484		count	576 16 7		
4,554					2,007 1 5	
			INVESTMENTS, AT COST.			
			General :			
			£5,000 L.N.E.R. 4% 2nd Guaran-			
	—		teed Stock	4,821 13 6		
			£4,824 Southern 5% Guaranteed			
	—		Stock	6,377 17 3		
	5,500		£5,500 3% Savings Bonds . . .	5,500 0 0		
	—		£1,010 2½% Treasury Stock . .	1,010 0 0		
	1,000		Local Loans	—		
	11,074		War Loan	—		
17,574					17,709 10 9	
			War-Time Emergency Fund :			
	1,000		£1,000 3% Defence Bonds . . .	1,000 0 0		
	375		500 15*s.* War Savings Certificates .	375 0 0		
	150		150 £1 War Savings Certificates .	150 0 0		
	950		£950 2½% National War Bonds .	950 0 0		
	1,950		£1,950 3% Savings Bonds . . .	1,950 0 0		
4,425					4,425 0 0	
			Endowment Fund :			
	1,000		£1,000 3% Defence Bonds . . .	1,000 0 0		
	1,285		£1,285 3% Savings Bonds . . .	1,285 0 0		
			£7,700 L.N.E.R. 3% Debenture			
	—		Stock	7,562 17 0		
			£176 Southern 5% Guaranteed			
	—		Stock	233 4 6		
			£5,000 L.M.S. 4% Guaranteed			
	—		Stock	5,215 4 3		
			£5,000 L.M.S. 5% Redeemable			
	—		Preference Stock, 1955 . . .	5,113 14 3		
	17,515		War Loan	—		
	19,800				20,410 0 0	
47,834						46,513 5 2
247,836						£46,513 5 2

THE INSTITUTE OF METALS.

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 30 JUNE 1947.

EXPENDITURE.

30.6.46.			£ s. d.	£ s. d.
£	£			
4,102		To Salaries and National Insurance	6,129 18 8	
71		,, Superannuation	520 8 10	
411		,, Pensions	438 0 0	
106		,, Lighting and Heating	133 19 11	
771		,, Rent and Insurance	769 1 7	
333		,, Postage and Telephone	531 5 3	
585		,, Printing and Stationery	770 11 0	
17		,, Sundry Expenses	59 4 11	
127		,, Travelling and Secretarial Expenses	278 15 11	
43		,, Committee Expenses	86 18 9	
516		,, Library Expenses	527 9 4	
22		,, Subscriptions	16 16 0	
198		,, Grants to Local Sections	197 0 0	
195		,, Meeting Expenses	382 11 2	
67		,, Repairs, Renewals, Office Equipment, and Furniture	183 9 4	
6		,, Bank Charges, *less* Interest	32 19 1	
37		,, Professional Charges	47 5 0	
312		,, National Certificates in Metallurgy	325 0 0	
250		,, Institution of Metallurgists	—	
100		,, Joint Education Committee	—	
8,269				11,430 14 9
		To *Excess of Expenditure over Income on :* Journal and Metallurgical Abstracts Account	341 10 11	
—				
634		,, Special Publications Account	16 12 8	
		(For details see separate Accounts.)		
634				358 3 7
133		Excess Income		—
£9,036				£11,788 18 4

INCOME.

30.6.46.			£ s. d.	£ s. d.
£	£			
7,060		By Annual Subscriptions		7,790 10 10
		,, Interest on Investments :		
	575	General Fund	460 9 10	
	675	Endowment Fund	571 17 4	
1,250				1,032 7 2
—		,, Profit on Sale of Investments		134 13 4
6		,, Sundry Receipts		15 6 7
720		*Journal*—Excess Income		—
9,036				8,972 17 11
—		By *Excess of Expenditure over Income for the Year*		2,816 0 5
£9,036				£11,788 18 4

JOURNAL AND *METALLURGICAL ABSTRACTS* ACCOUNT.

£	£		£ s. d.	£ s. d.
1		To Stock of *Journals* at 30 June 1946		1 0 0
3,206		,, Monthly *Journal*—Printing, Drawings, and Blocks	4,871 14 4	
75		,, *Journal* Volumes	113 3 5	
373		,, *Metallurgical Abstracts* Volumes	269 16 11	
401		,, Packing, Despatch, and Postage	592 19 6	
212		,, Abstractors and Reviewers Fees	326 16 6	
140		,, Miscellaneous Expenditure	99 11 0	
73		,, Binding for Sale	310 17 6	
—		,, Reprints of Papers	176 17 1	
4,480				6,761 16 3
720		Excess Income		

£	£		£ s. d.	£ s. d.
		By Sales of Publications (except Special Publications)	2,938 13 4	
	2,415	,, Receipts from Advertisements *less* Agents' Charges	3,481 12 0	
	2,785			
5,200				6,420 5 4
1		,, Stock of *Journals* at 30 June 1947		1 0 0
—		,, Excess of Expenditure over Income for the Year		341 10 11

THE INSTITUTE OF METALS.

SPECIAL PUBLICATIONS ACCOUNT.

30.6.46.	EXPENDITURE.	£ s. d.	30.6.46.	INCOME.	£ s. d.
£			£		
21	To Royalties on Monographs Nos. 1 and 3	78 16 0	750	By Balance at 30 June 1946	750 0 0
583	,, Printing Monograph No. 3	248 16 11	149	,, Sales	630 4 9
17	,, Printing Monograph No. 4	291 11 2	10	,, Bank Interest	9 9 5
46	,, Annotated Equilibrium Diagrams	37 2 9	634	,, Excess of Expenditure over Income for the Year	16 12 8
49	,, Contents List	—			
77	,, Reprinting Mono. No. 1	—			
750	,, Balance at 30 June 1947	750 0 0			
£1,543		£1,406 6 10	£1,543		£1,406 6 10

(Stock of Publications valued at one-half selling price amounts to £440.)

ENDOWMENT FUND.

£		£ s. d.	£ s. d.	£		£ s. d.
	To *Transfer to General Funds :*			20,012	By Balance at 30 June 1946	20,292 3 11
675	,, Income from Investments	563 9 6		270	,, Subscriptions and Donations Received	90 0 0
—	,, Income Tax Recovered, 1945–46	8 7 10		683	,, Interest on Investments	563 9 6
			571 17 4	2	,, Bank Interest	2 14 3
20,292	,, Balance at 30 June 1947		20,986 16 7	—	,, Profit on Sale of Investments *less* Loss on Sale	610 6 3
£20,967			£21,558 13 11	£20,967		£21,558 13 11

WAR-TIME EMERGENCY FUND.

£		£ s. d.	£		£ s. d.
—	To Amount transferred to General Funds	3,050 0 0	7,529	By Balance at 30 June 1946	7,767 6 3
7,767	,, Balance at 30 June 1947	4,909 15 2	111	,, Interest on Investments	111 11 6
			75	,, Bank Interest	80 17 5
			2	,, Income Tax Recoverable	—
			50	,, Subscriptions	—
£7,767		£7,959 15 2	7,767		£7,959 15 2